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(71) Applicant(s)
The Dialog Corporation Plc
(Incorporated in the United Kingdom)
The Communications Building, 48 Leicester Square,
LONDON, WC2H 7DB, United Kingdom

(72) Inventor(s)
Llewelyn Ignazio Fernandes
Rachel Hammond

(74) Agent and/or Address for Service
Atkinson & Co
First Floor, Unit A, The Technology Park,
60 Shirland Lane, SHEFFIELD, S9 3PA,
United Kingdom

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G4A AUSB

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US 5598557 A

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INT CL⁶ G06F 17/30

(54) Abstract Title
Automatic classification of text files

(57) Text files are automatically categorised by examining the files for occurrences of keywords indicative of a category. A score is adjusted in response to the occurrences of the keywords, and a classification of the text file to a category is made if the score exceeds a threshold. Because longer files will tend to produce more occurrences than short files of equal relevance, the scores for files shorter than a certain length T are increased by a weighting factor K which is inversely related to the file size S. Plural words and phrases may be sought in each file and the scores accumulated in dependence on the occurrence of these terms. A branching hierarchical file assessment structure may be used, in which case score adjustment may be performed by changing scoring coefficients stored at branches (figures 6-8).

FILE WEIGHTING FACTOR, W, IS GIVEN BY:

IF $S < T$

$$W = \left(\frac{T - S}{T} \right) N + 1$$

ELSE

$$W = 1$$

WHERE

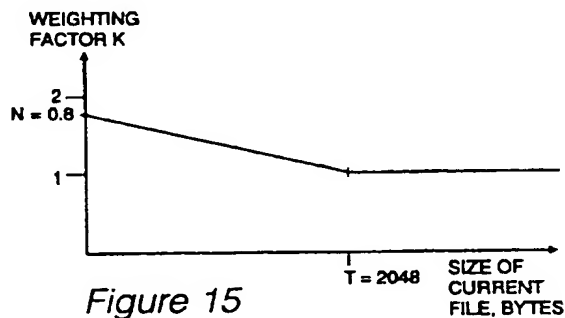
T = THRESHOLD VALUE

S = SIZE OF CURRENT FILE

N = WEIGHTING CONSTANT, IE. 0.8

IE.

$$\text{WHEN } S < 2048, W = \left(\frac{2048 - S}{2048} \right) 0.8 + 1$$



GB 2 336 699 A

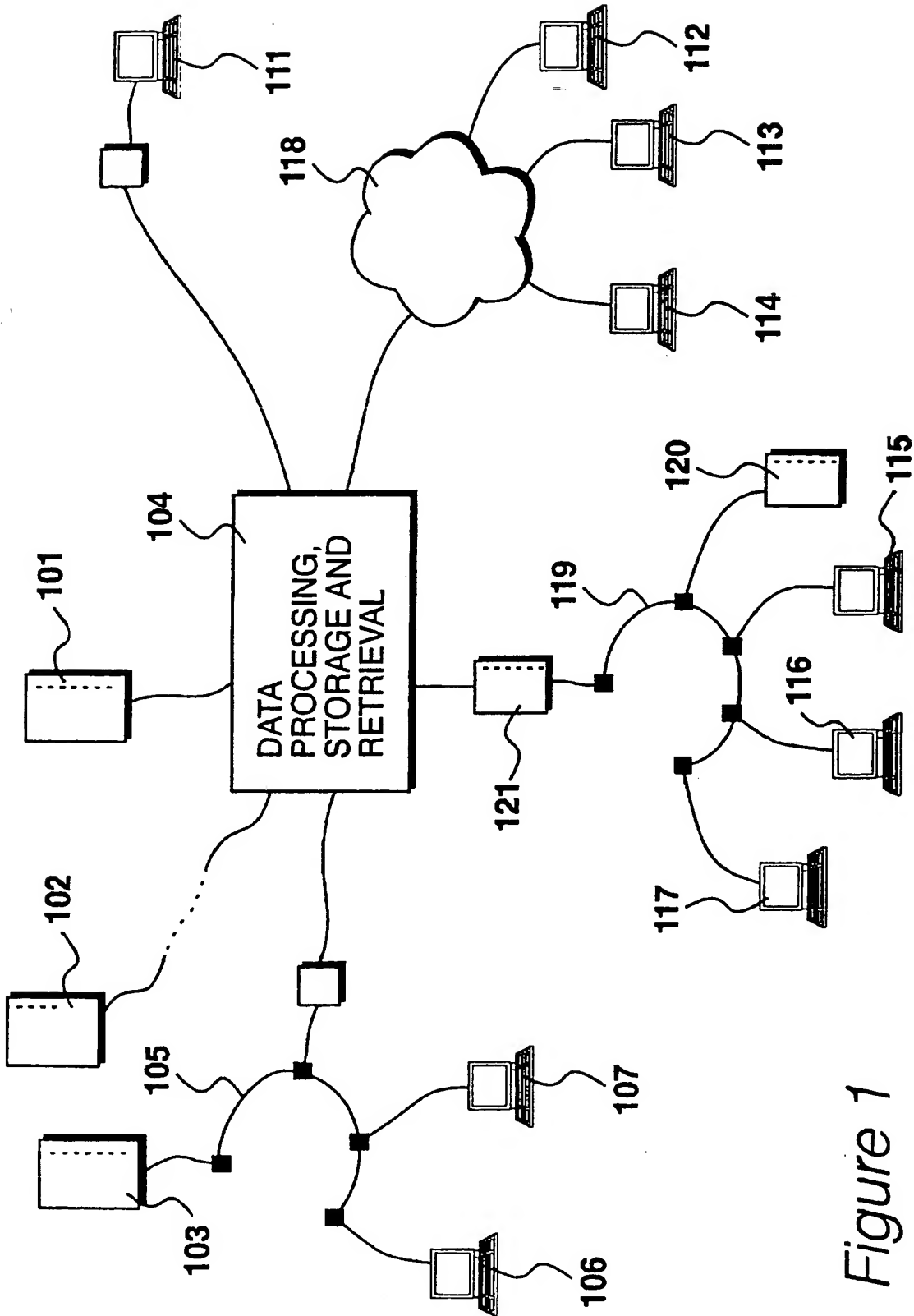
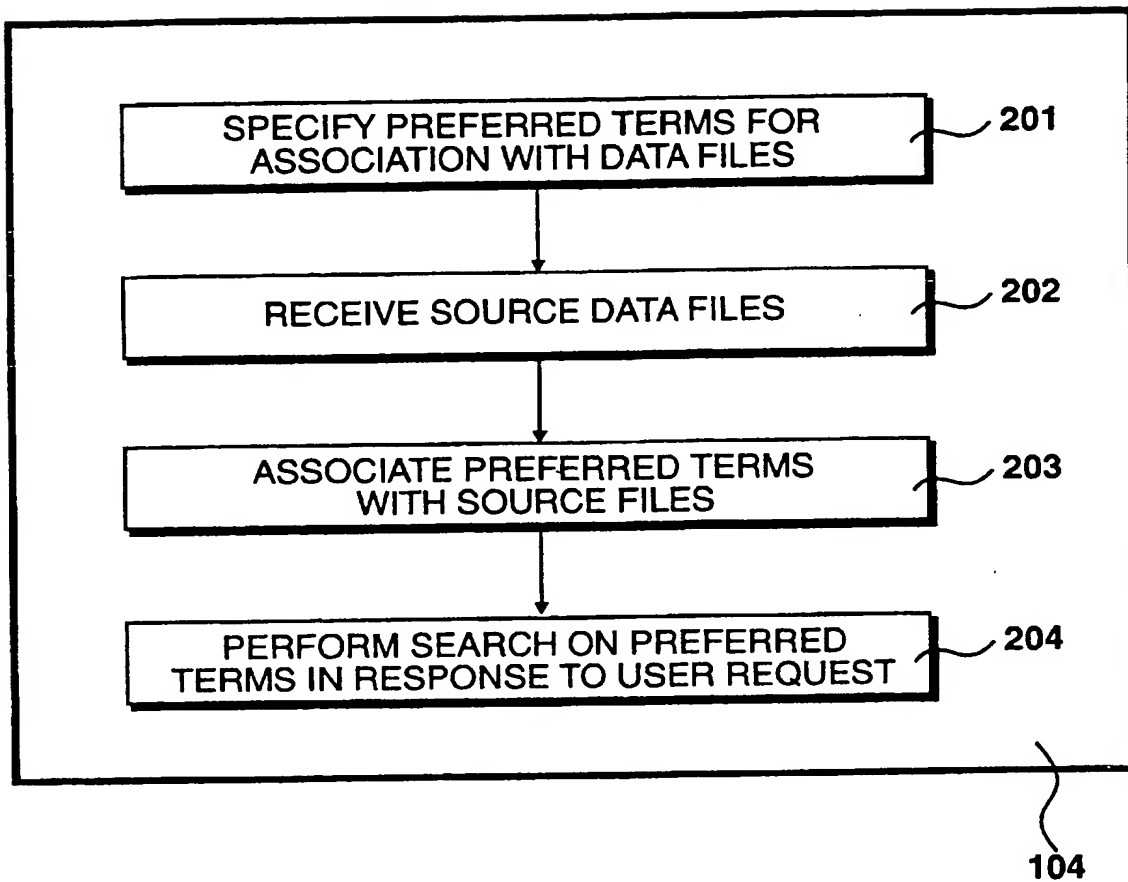


Figure 1

*Figure 2*

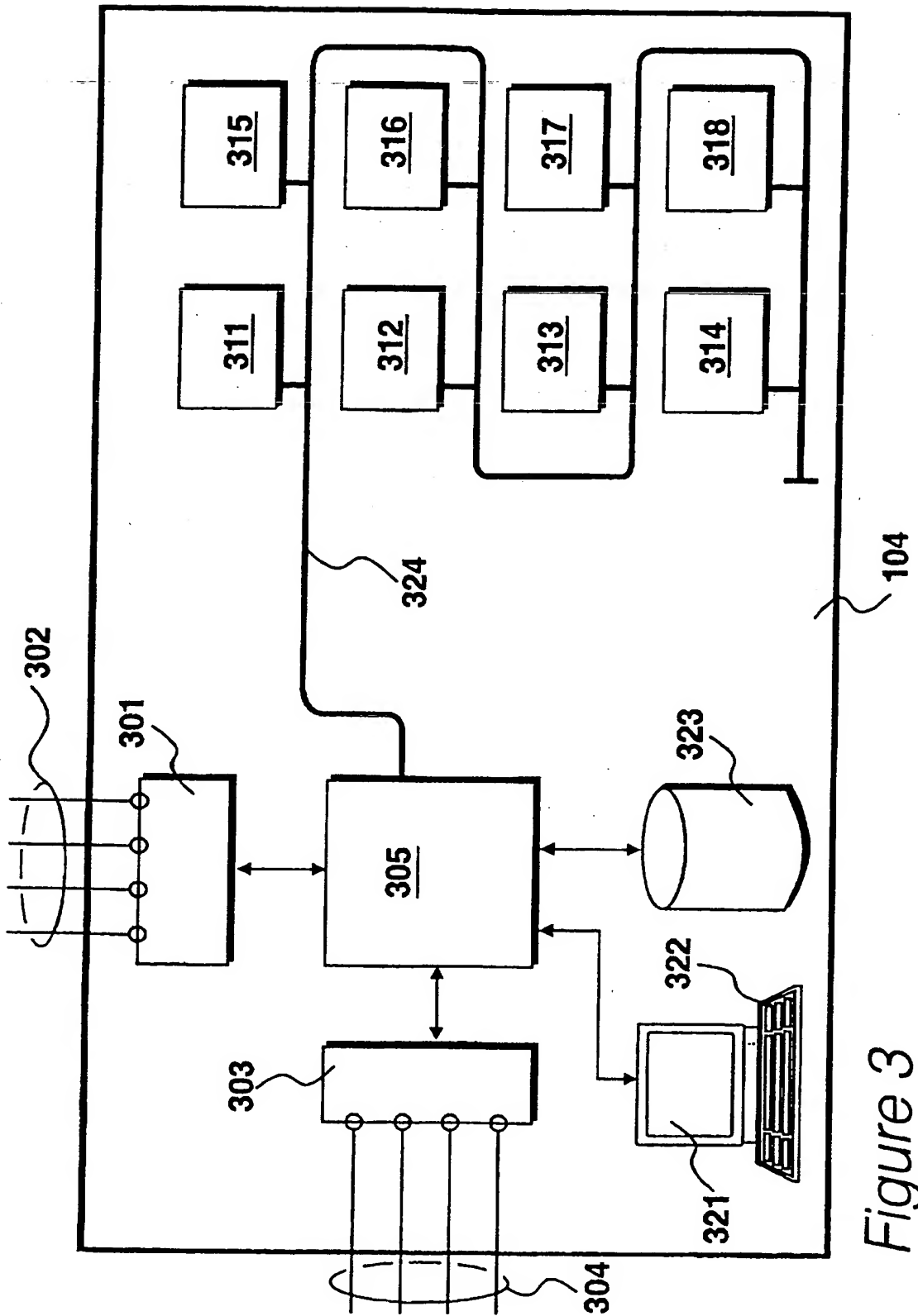
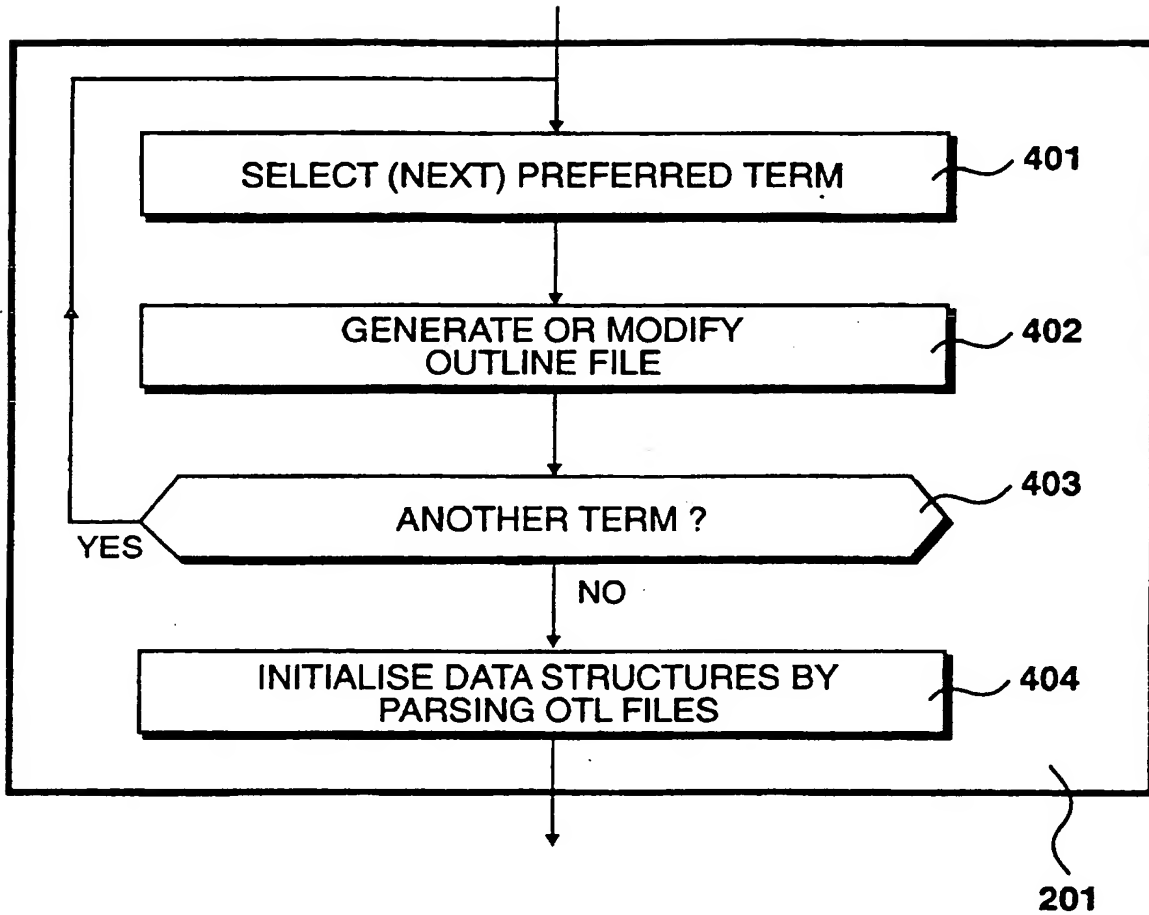
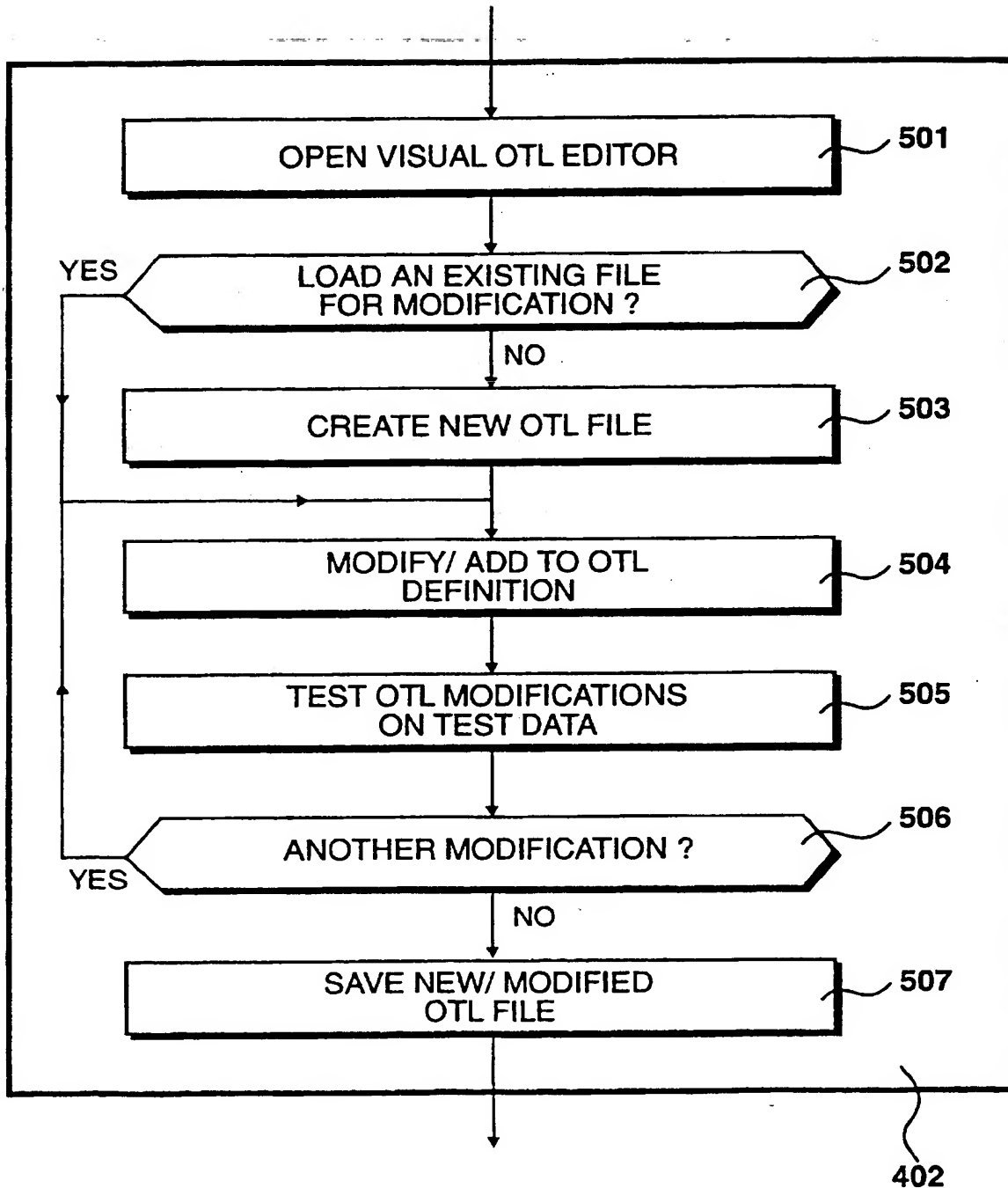


Figure 3

*Figure 4*

*Figure 5*

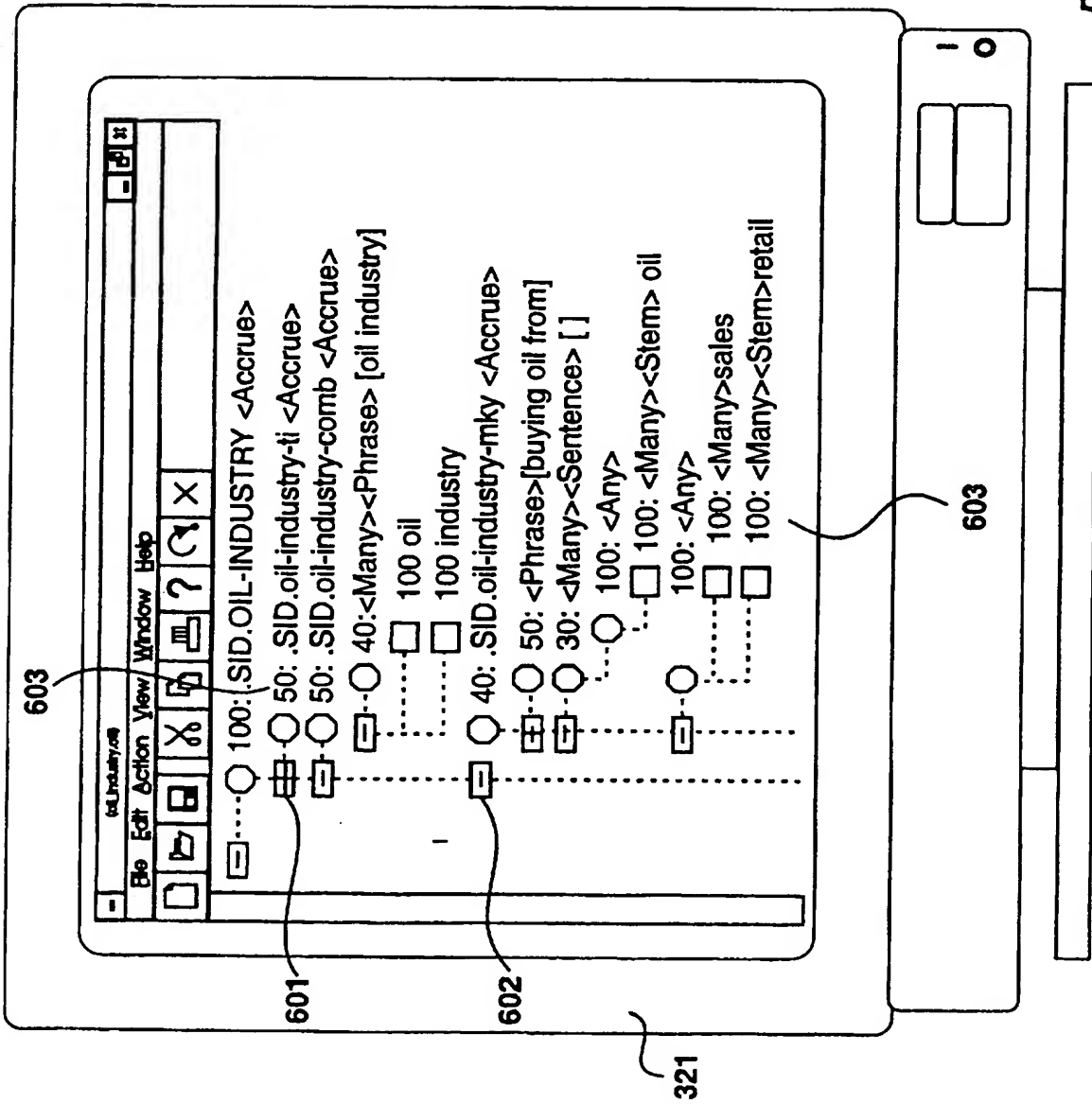


Figure 6

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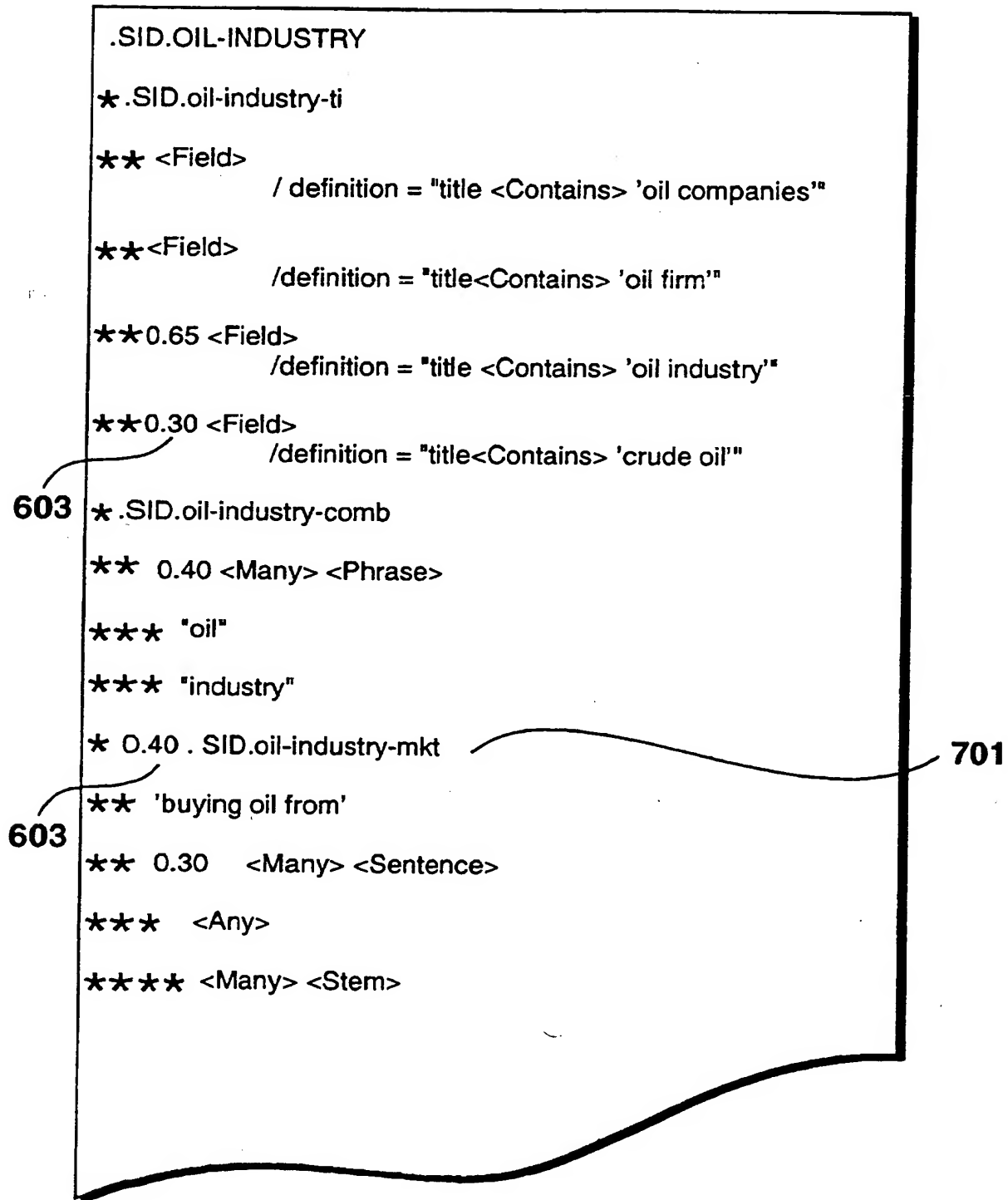


Figure 7

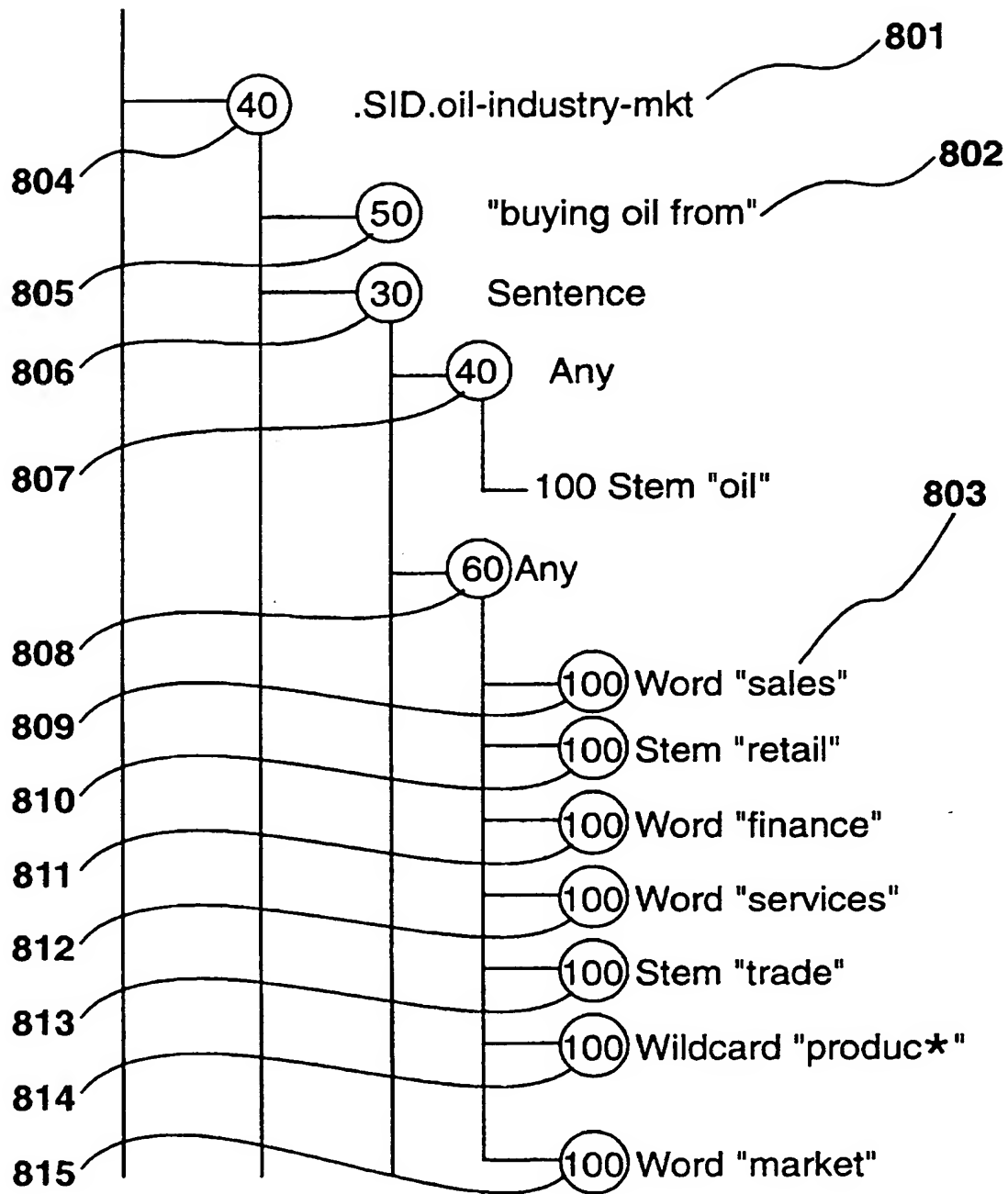


Figure 8

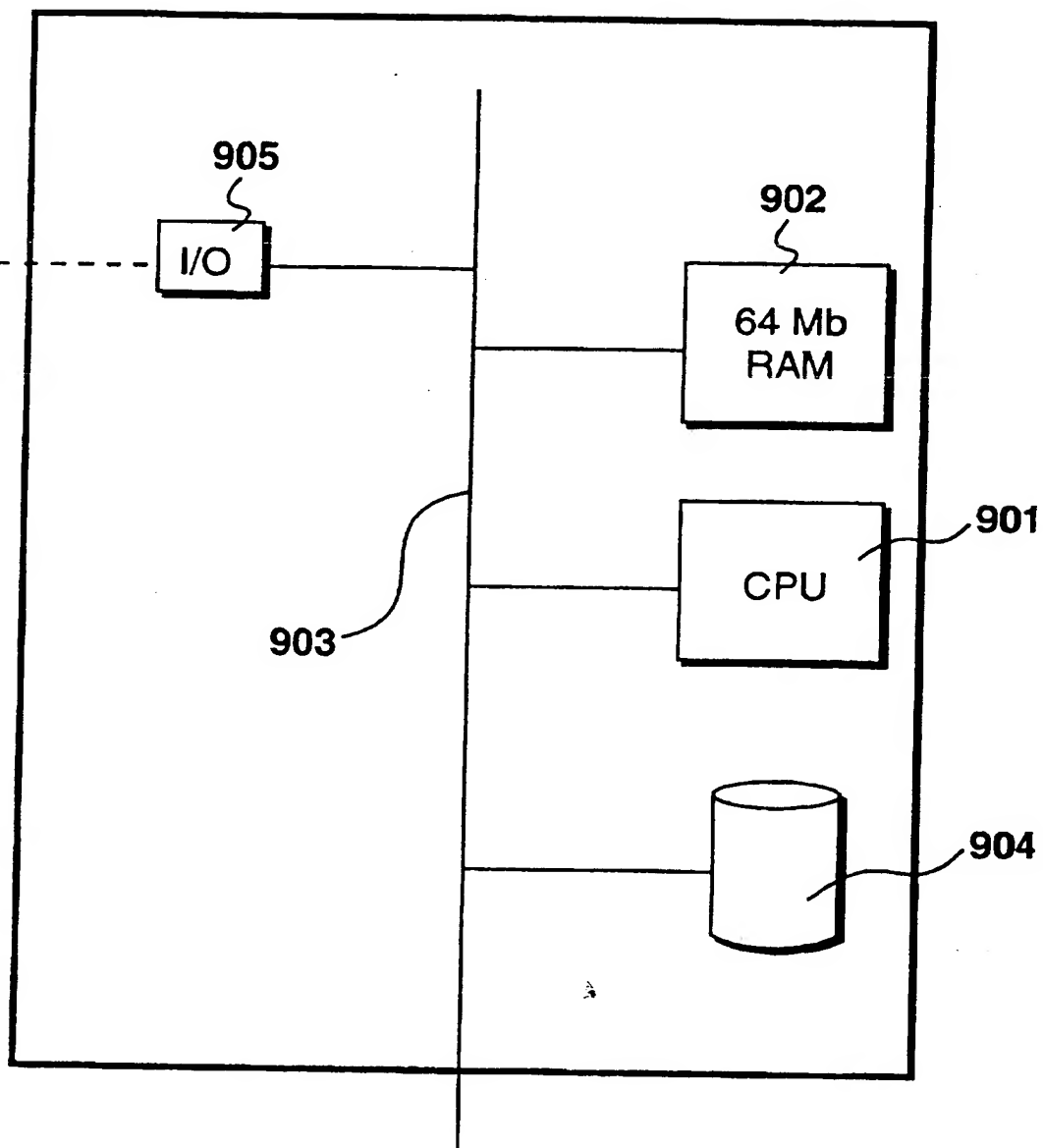


Figure 9

10/23

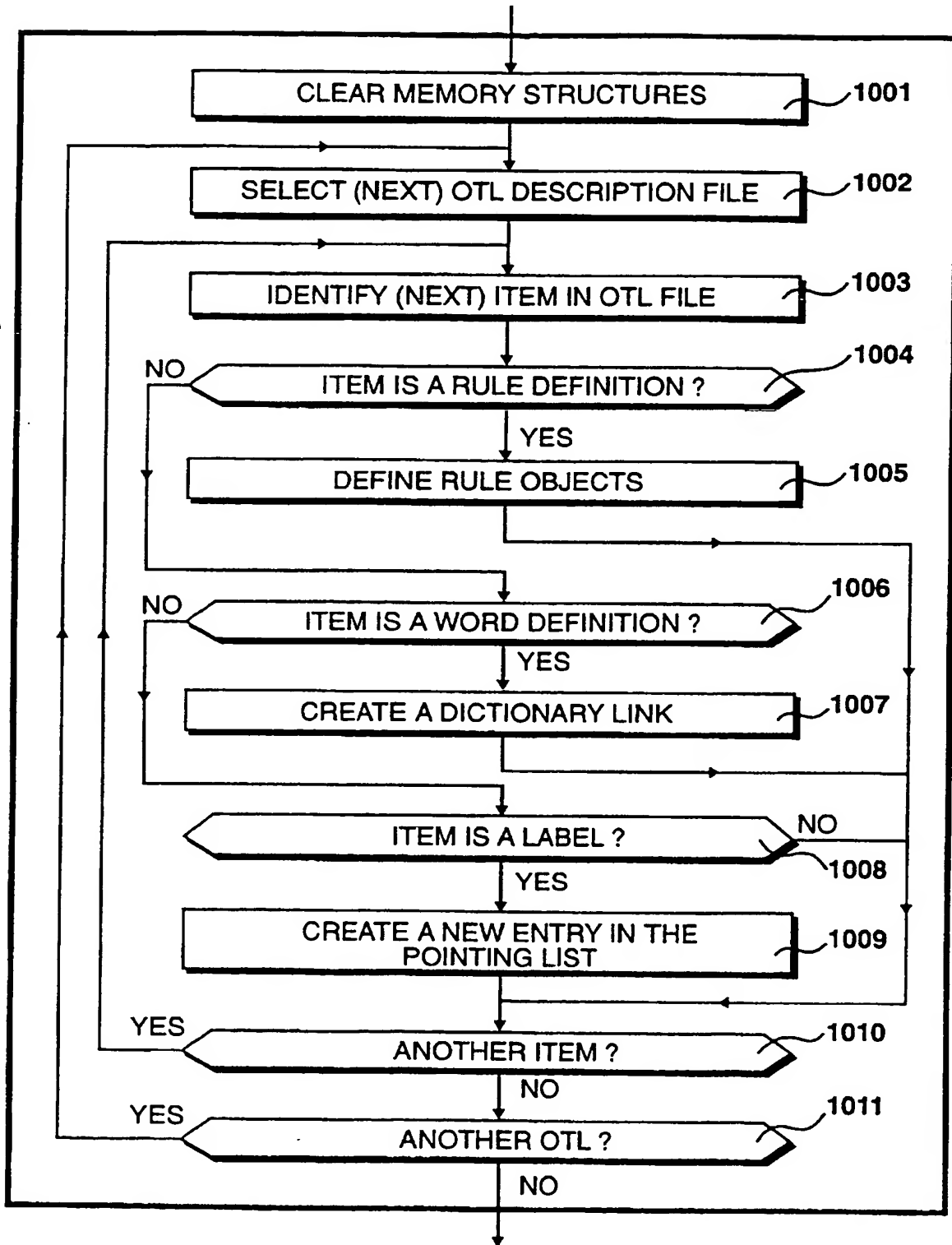


Figure 10

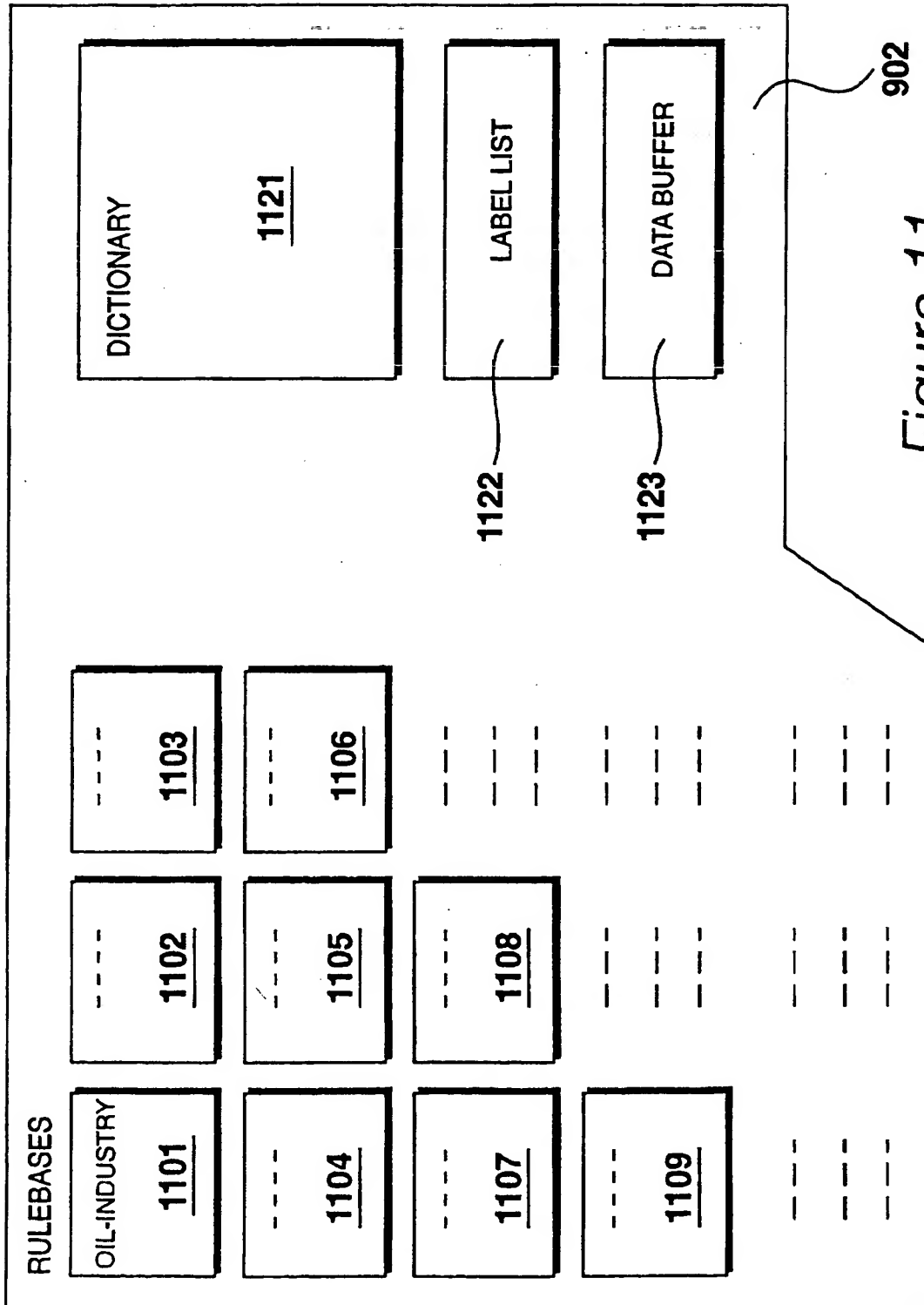


Figure 11

12/23

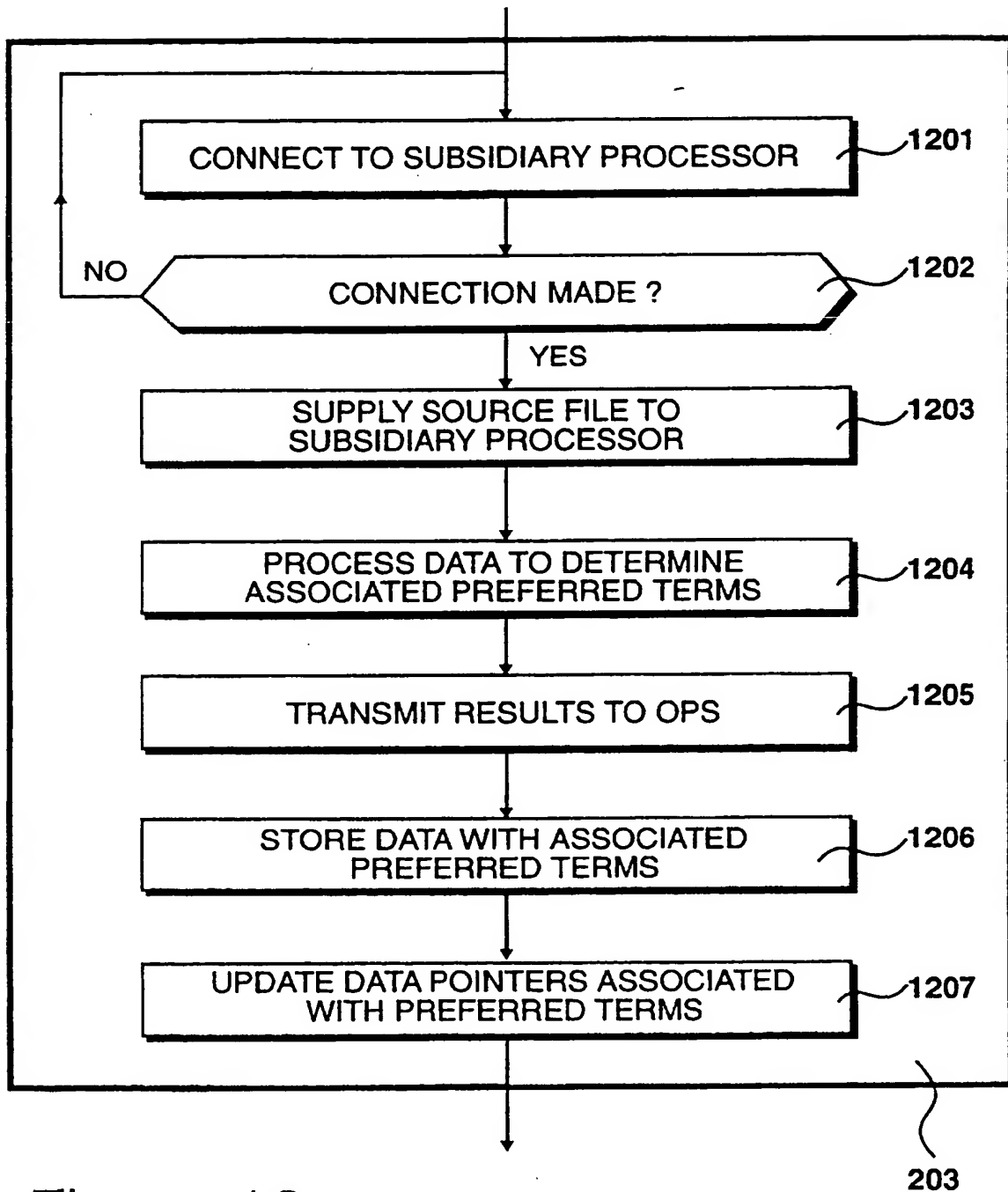


Figure 12

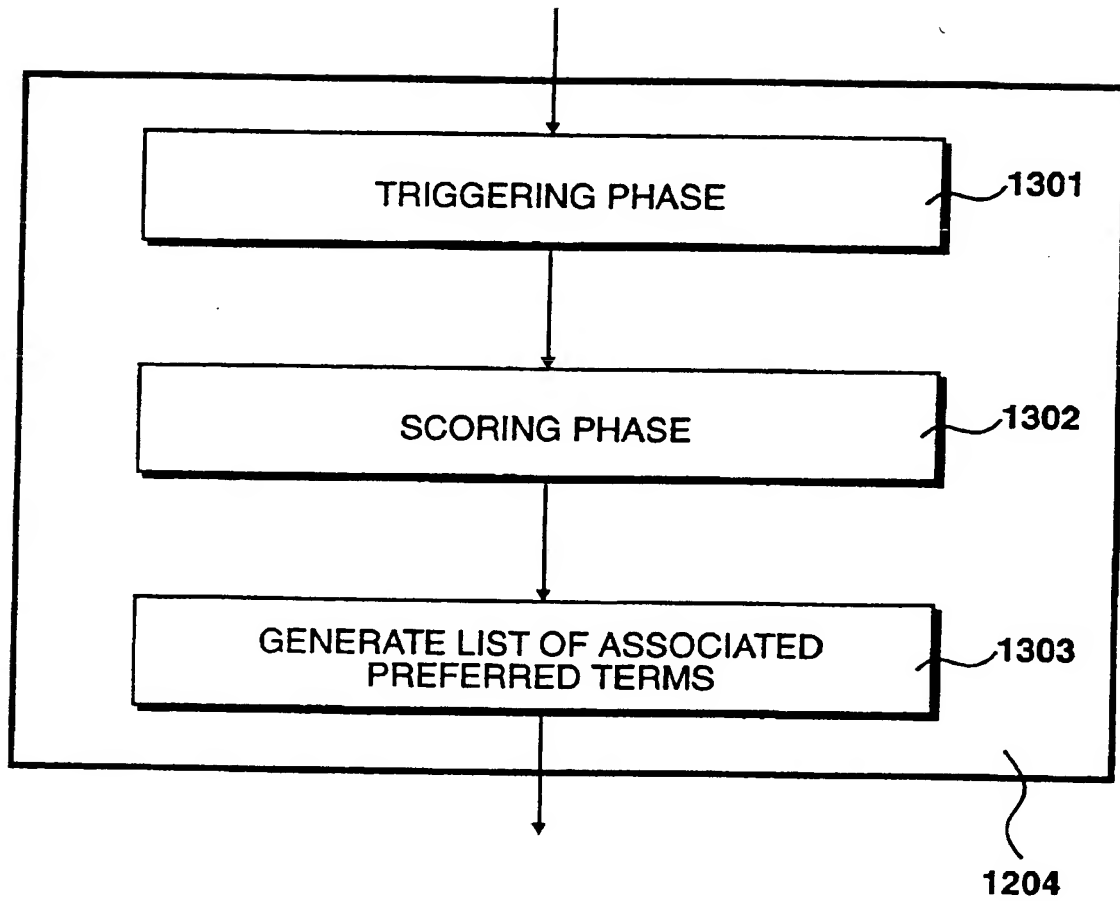


Figure 13

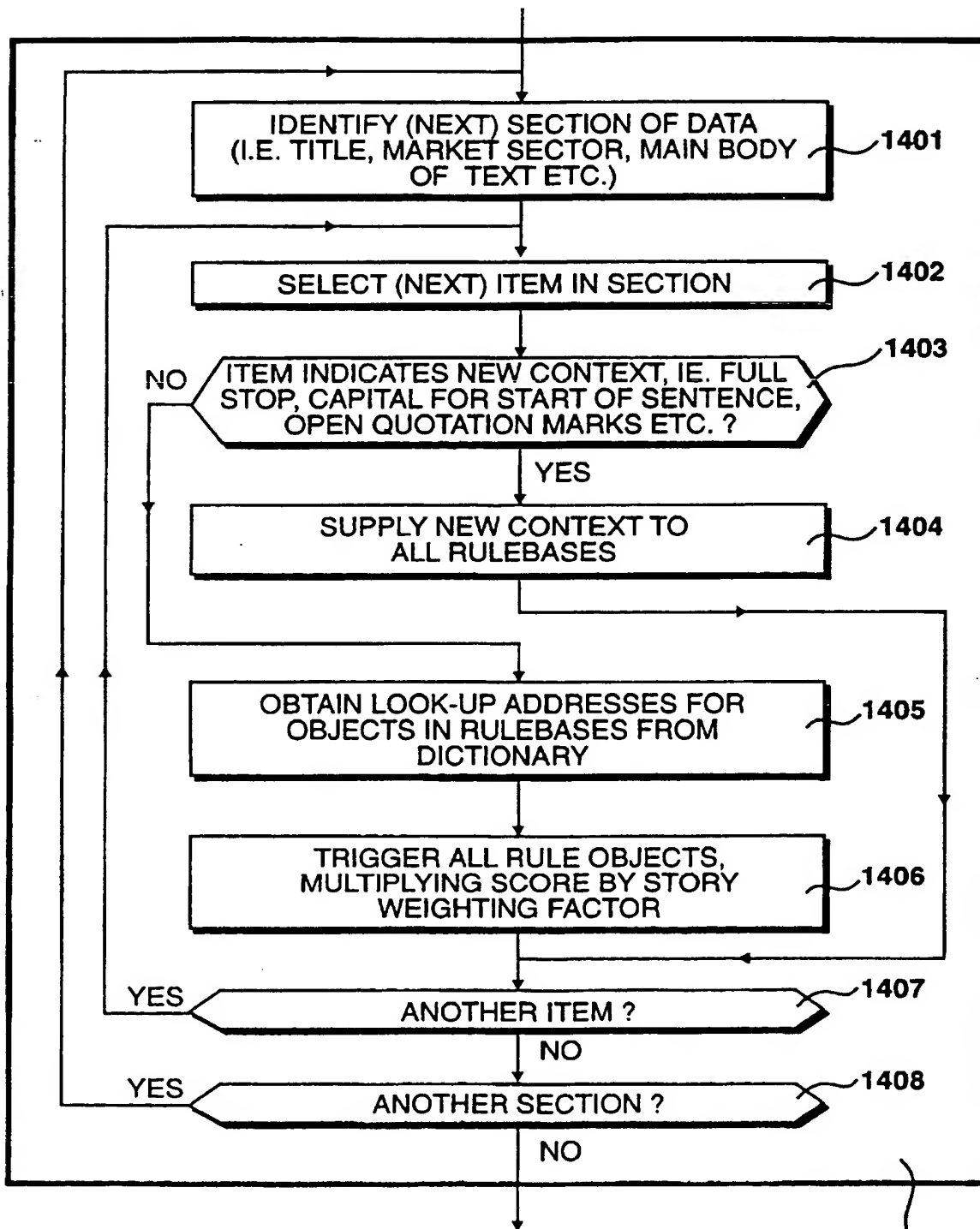


Figure 14

1301

15/23

FILE WEIGHTING FACTOR. W, IS GIVEN BY :

IF $S < T$

$$W = \left(\frac{T - S}{T} \right) N + 1$$

ELSE

$$W = 1$$

WHERE

T = THRESHOLD VALUE

S = SIZE OF CURRENT FILE

N = WEIGHTING CONSTANT, IE. 0.8

IE.

$$\text{WHEN } S < 2048, W = \left(\frac{2048 - S}{2048} \right) 0.8 + 1$$

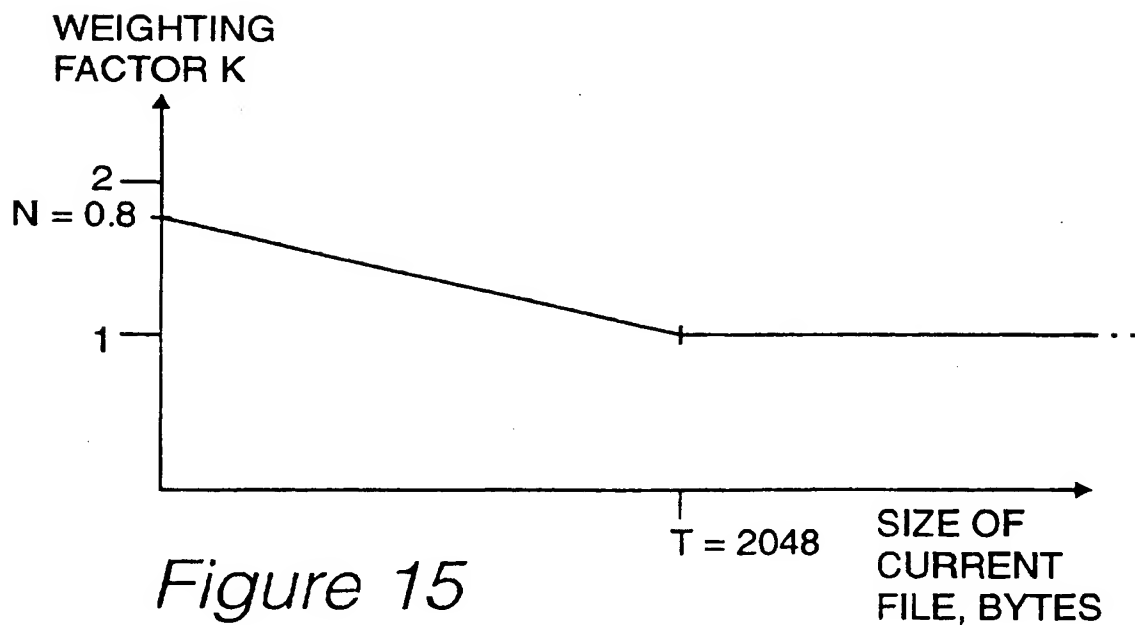


Figure 15

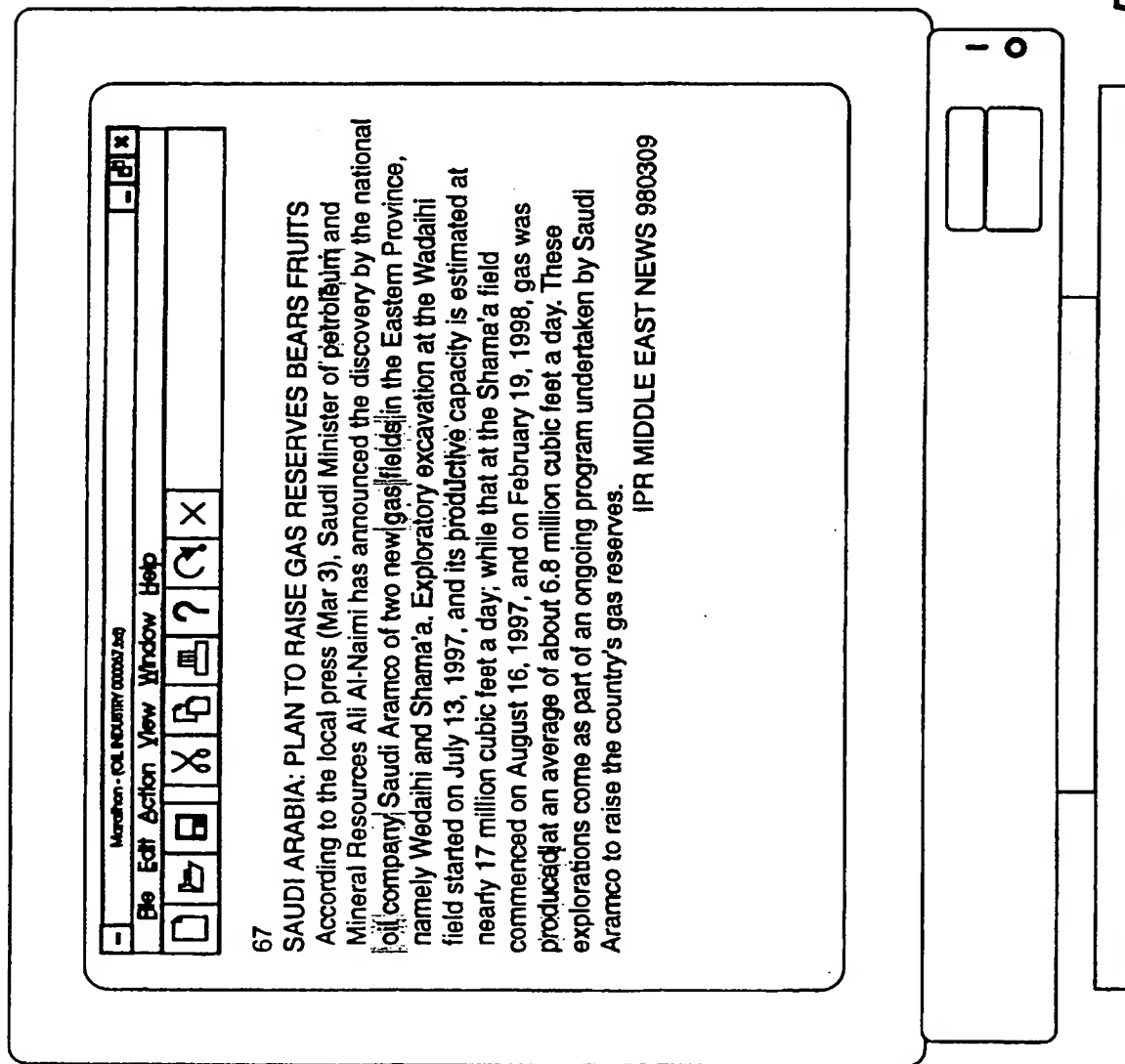


Figure 16

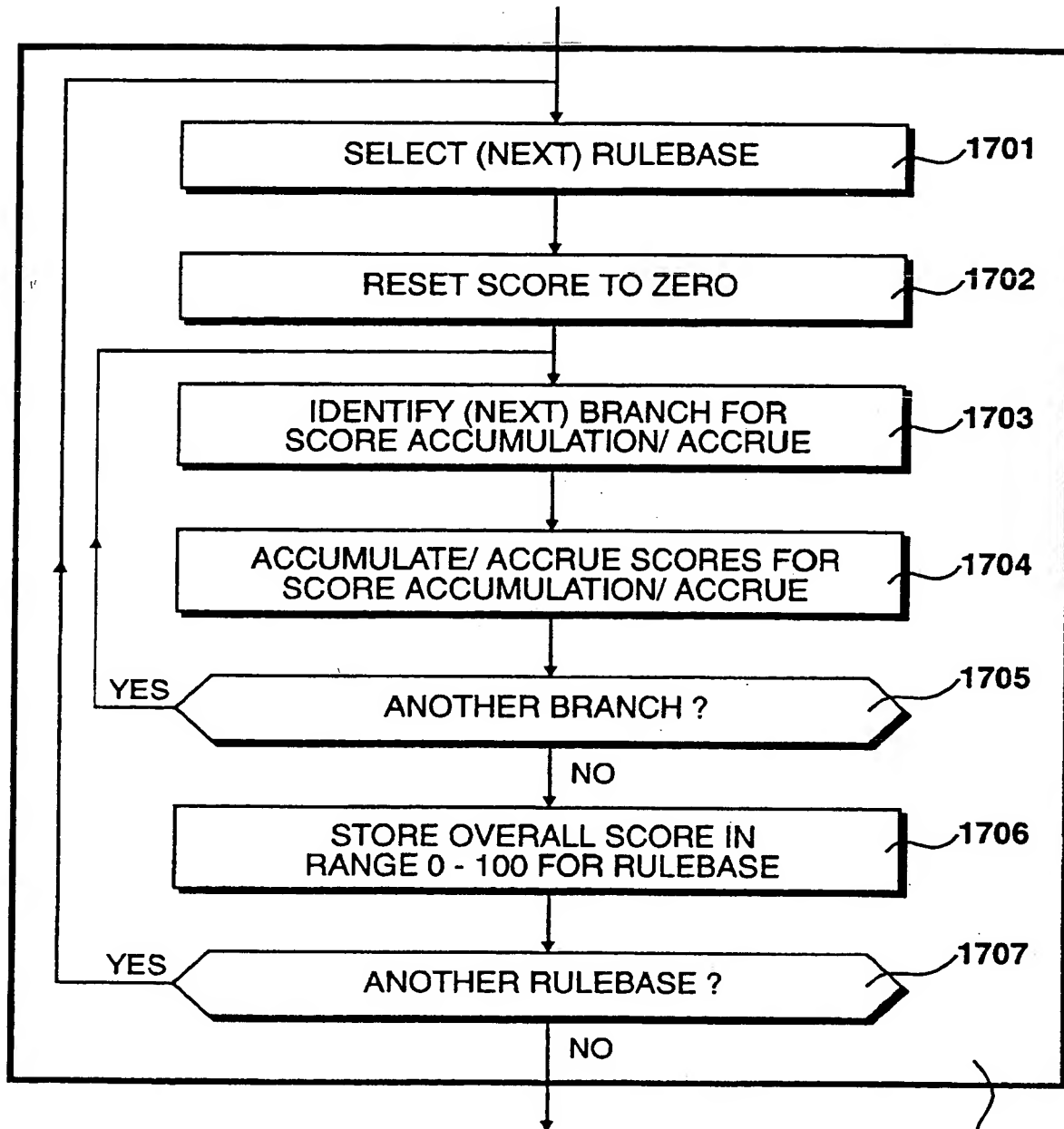


Figure 17

1302

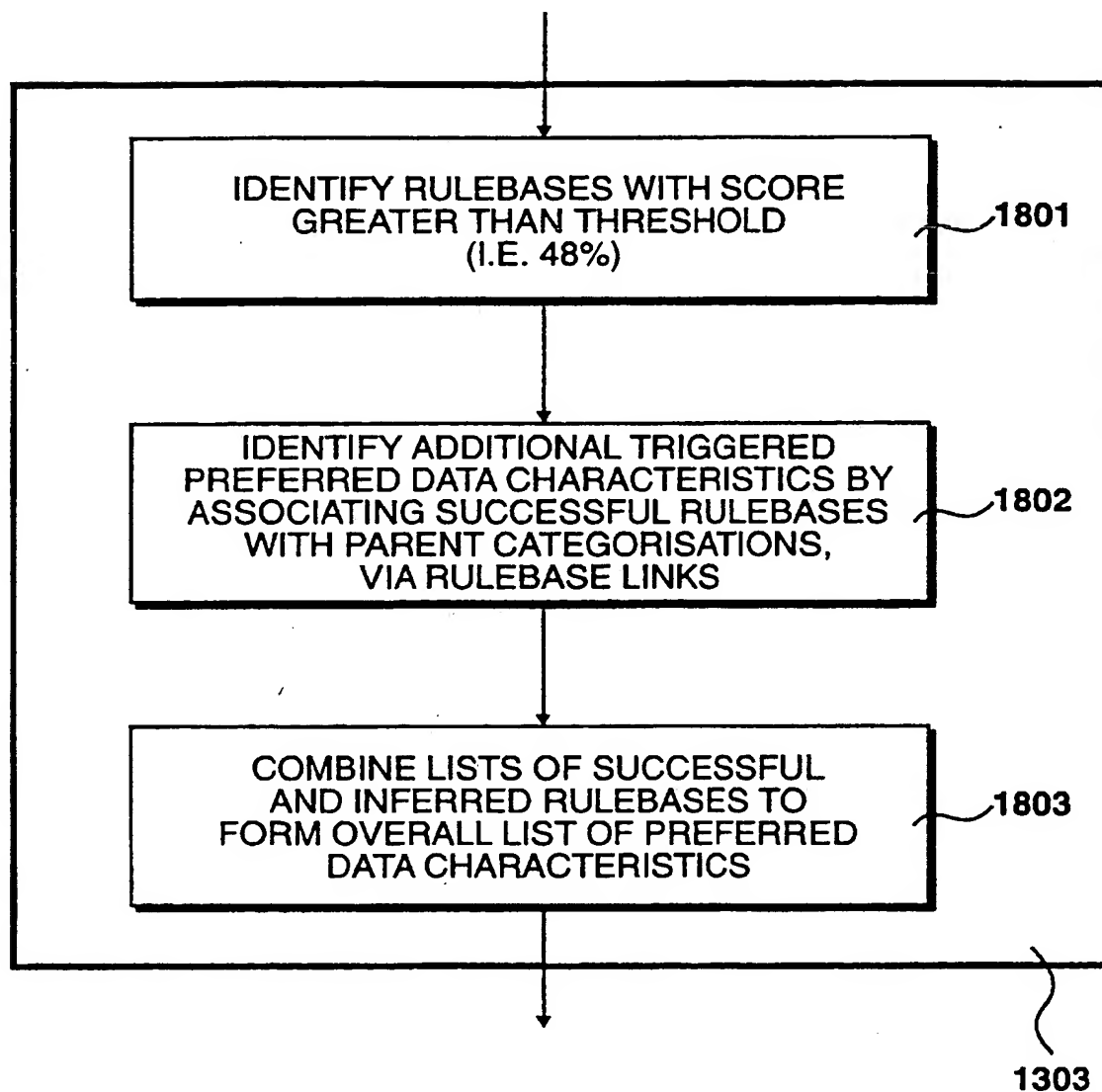


Figure 18

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1901 PREFERRED TERM	1902 POINTER
OIL_INDUSTRY	OF8912
OIL_INSTITUTIONS	192AC3
OIL_	516321
PETROLEUM_	3200FI
⋮	⋮
⋮	⋮
⋮	⋮
⋮	⋮
⋮	⋮

Figure 19

2001 ADDRESS	2002 FILE NAME	2003 POINTER
OF8912	Oil_industry_netherland_3	OF8A20
OF8A20	Oil_ind_india_flash_	OF8193
OFA193	Petrochem_times.3.9.97	100AB1
100AB1	[END]	000000
⋮		
192AC3	BP.index_ft_uk_97	20A21B
⋮		

Figure 20

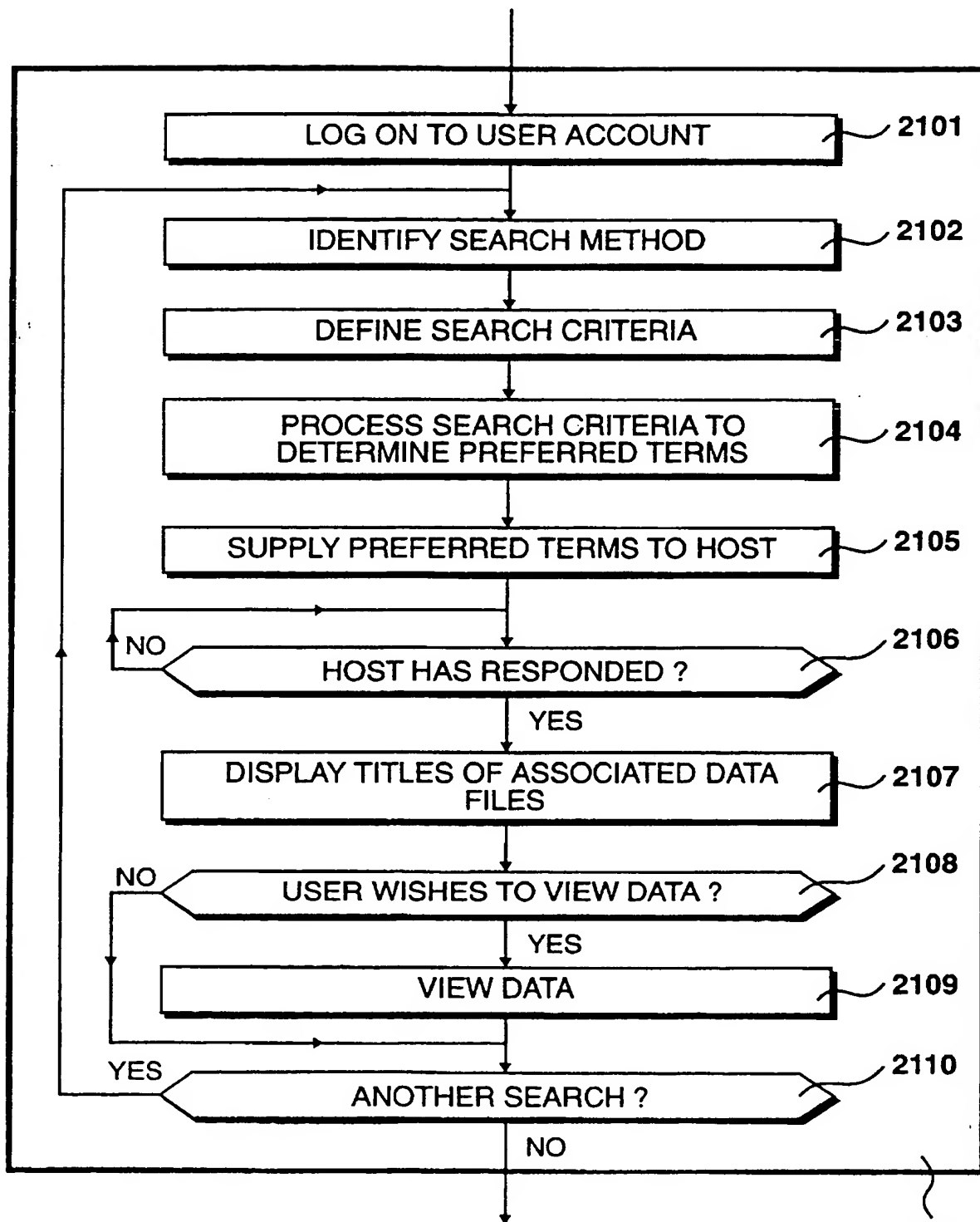


Figure 21

home

Database: News Titles: 10 Sort: Pub. Date Ascending:

Market Sector: Pub. Date: From: To: dd/mm/yy

Companies: Countries: Publisher: Scope:

Free text: stage Title:

Use Saved Search

home • Dossier • Portfolio • Alert Manager • Utilities • Client Resources • Help?

Figure 22

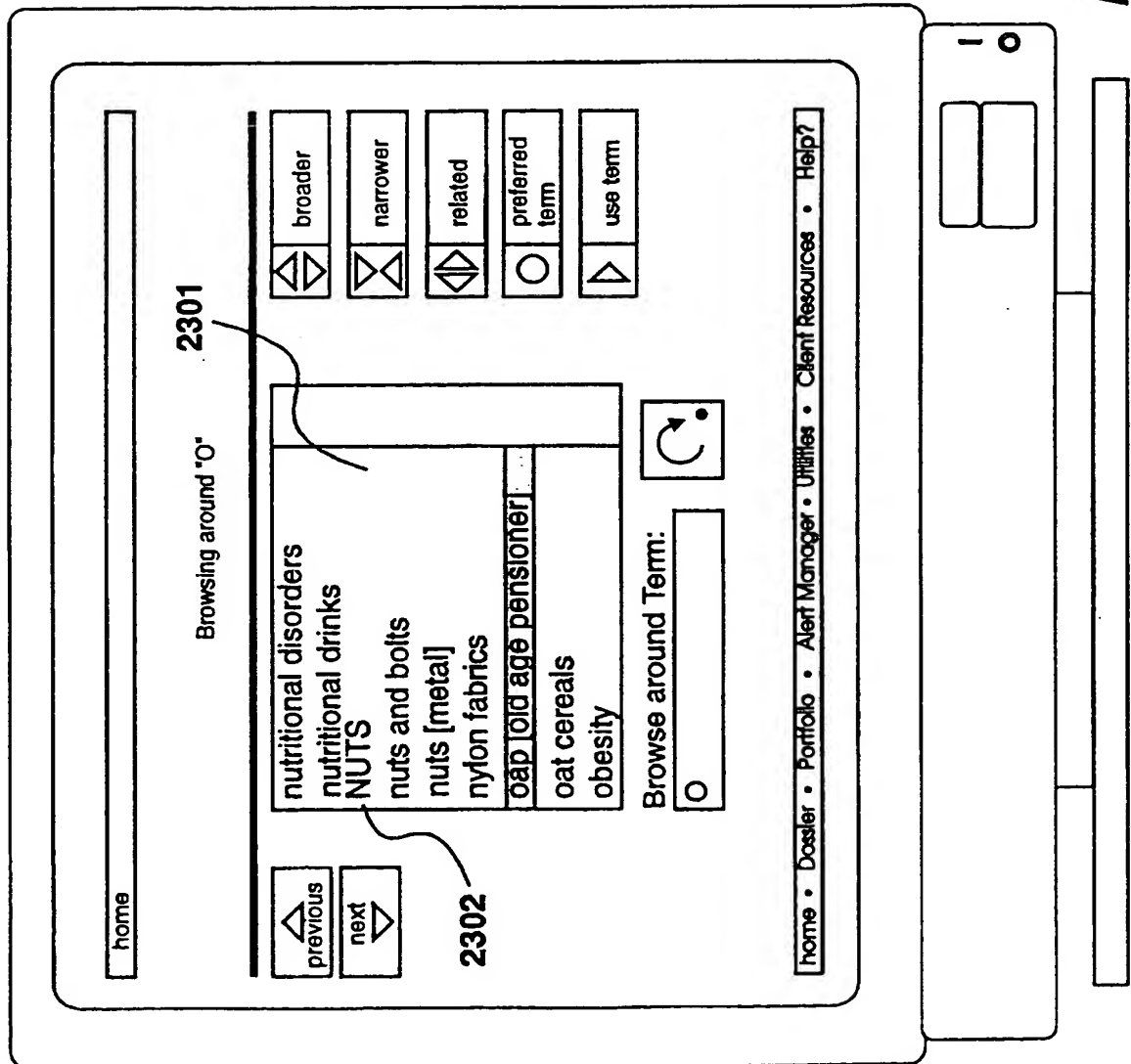
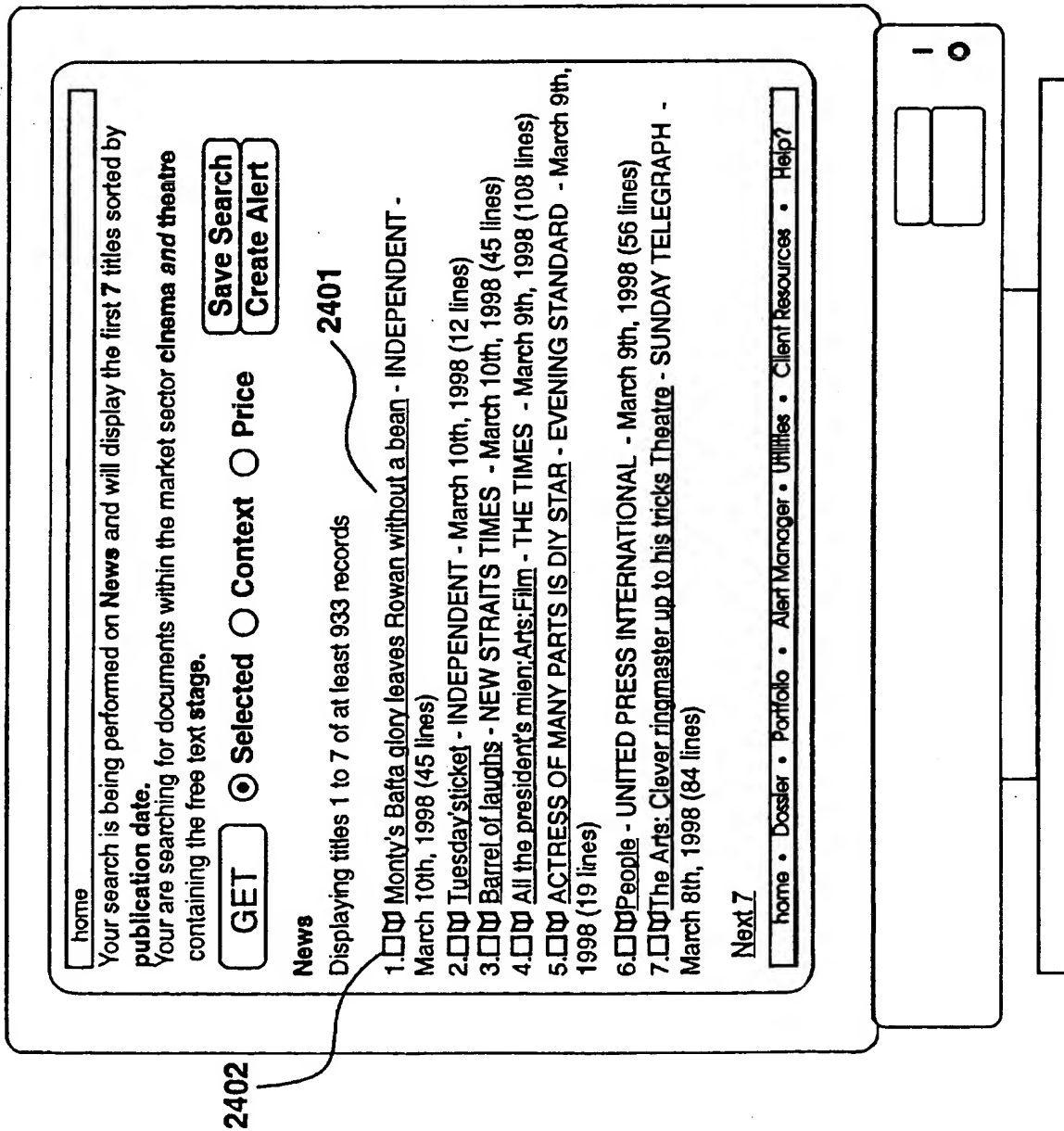


Figure 23



ASSOCIATING FILES OF MACHINE-READABLE DATA WITH SPECIFIED INFORMATION TYPES

The present invention relates to associating files of machine-readable data with specified information types so as to enhance the availability of information from a database in which users access databases via transmission channels.

Introduction

Traditionally, database technology has been dedicated to the organisation of numerical and tabular data and it is only recently, particularly with the expansion of the Internet, that demand has grown significantly for the retrieval of text-based files. Several facilities are available on the Internet, commonly referred to as "search engines" which assist in the location of information. The majority of these operate by performing what has become known as "free text" searching, in which a user specifies words which they believe are contained within the target file as a mechanism for instructing the system to retrieve files of interest.

Problems with this technique are well known to users of the available search engines, and a simple enquiry can generate hundreds of thousands of "hits", the majority of which will tend to be totally irrelevant to the user's needs. Furthermore, other relevant files may be missed simply because they do not contain the specific chosen words.

As is well documented, a problem with the Internet is that the freedom of the Internet is also its downfall. Information is not classified before it is made available, therefore it is highly likely that even the simplest search will fail to identify relevant documentation and will take a considerable period of time to perform.

Procedures for classifying volumes of data so as to facilitate

subsequent searching are known but these classification processes often involve manual intervention, thereby making them time consuming and prone to human error. Furthermore, except in circumstances where the documentation is considered to be extremely valuable and will continue to be required over a significant period of time, the cost of performing this manual exercise cannot be justified in terms of the commercial worth of the data sources being considered. Consequently, the problem results in much data being effectively inaccessible and outside the realm of searchable knowledge.

Procedures are known for processing a data file so as to determine whether the data file should be associated with a particular information category. The known processes require a machine readable association file, also known as an outline file and usually identified by file extension .OTL. In this way, it is possible for the incoming data file to be processed with reference to one or many outline files whereupon each outline file produces a numerical score value defining an extent to which the data file is relevant to an associated category, whereafter a decision may be made on the basis of a threshold comparison.

In practical systems, thousands of such outline files would be required in order to provide a useful level of categorisation. In the present applicant's co-pending British patent application (DGC-P11-GB) a method of generating machine readable association files is described. A plurality of data files are manually selected as being examples of files which should be associated with a particular category. In addition, a plurality of files are selected manually which are considered not to be associated with a particular category. Having identified these files, the process identifies preferred term candidates from the associated files, weights these candidates with reference to files not associated with the category and applies terms to a machine readable association file by analysing the weighting values.

The resulting association files are particularly well suited to associating new data files which are of a substantially similar size to the original source data files. Similarly, association files generated by more traditional techniques still tend to be well suited to input data files of a particular size and less well suited to incoming data files of differing sizes. Thus, if a new incoming data file is smaller than the optimum file size, it is possible that relevant files will fail to be categorised given that the processing of these files will result in an inappropriately low weighting value being calculated.

Summary of The Invention

According to a first aspect of the present invention, there is provided a method of associating files of machine-readable data with information types, comprising steps of examining data elements in a file to identify occurrences of specified data types; adjusting a score in response to said identified occurrences; further adjusting said score in relation to a size of said data; and associating said information types with processed files dependent upon said score values.

In a preferred embodiment, the further adjustment is performed if the size of the data is below a predetermined threshold and a further adjustment may be performed up to a predetermined maximum weighting value.

In a preferred embodiment, the information types are expressed as preferred terms and are specified by information outlines. The information outlines may define preferred terms in a branching hierarchical structure and the adjustable values may be determined at branches of this structure. The further adjustment may include adjustment at a plurality of the branches and score values may be determined by multiplying values stored at branches throughout the hierarchy.

According to a second aspect of the present invention, there is provided apparatus for associating files of machine-readable data with information types, comprising examining means for examining data elements

in a file to identify occurrences of specified data types; adjusting means for adjusting a score in response to said identified occurrences and for adjusting said score in relation to said size of said data; and associating means for associating the information types with processed files dependent upon said score values.

In a preferred embodiment, the adjusting means is configured to further adjust the score inversely in relation to a size of said data. Preferably, means are included for determining the size of said data in terms of the volume of the stored file representing the number of characters present in the file.

Brief Description of The Drawings

Figure 1 shows a data distribution environment, including a data processing, storage and retrieval system;

Figure 2 illustrates procedures performed by the processing system shown in *Figure 1*, including a process for specifying preferred terms, a process for associating preferred terms with source files and a process for performing a search in response to a user request;

Figure 3 details the processing system shown in *Figure 1*, including subsidiary processing units;

Figure 4 details the process shown in *Figure 2* for specifying preferred terms for association with data files, including a process for the generation or modification of outline files;

Figure 5 details the step shown in *Figure 4* for the generation or modification of outline files;

Figure 6 illustrates a graphical view of an OTL file;

Figure 7 illustrates the actual OTL data for the graphical representation shown in *Figure 6*;

Figure 8 shows a diagrammatic representation of the data illustrated in *Figure 7*;

Figure 9 shows a subsidiary processor of the type identified in *Figure 3*;

Figure 10 shows operations performed by the processing unit shown in *Figure 9* in response to instructions read from the memory shown in *Figure 9*;

Figure 11 shows rule bases generated for each OTL file in response to the selection step shown in *Figure 10*;

Figure 12 details the step for associating preferred terms with source files identified in *Figure 2*, including a step for processing data to determine associated preferred terms;

Figure 13 details the step for processing data to determine associated preferred terms identified in *Figure 12*, including a triggering phase, a scoring phase and a list generation phase;

Figure 14 details the triggering phase identified in *Figure 13*;

Figure 15 details the generation of file weighting factor;

Figure 16 shows an example of a short data file;

Figure 17 details the scoring phase identified in *Figure 13*;

Figure 18 details the generation phase for a list of associated preferred terms identified in *Figure 13*;

Figure 19 illustrates a preferred term table, having pointers to a linked list;

Figure 20 details the linked list referred to in *Figure 19*;

Figure 21 details procedures performing a search in response to a user request identified in *Figure 2*;

Figure 22 illustrates a screen display generated by the requesting step shown in *Figure 21*;

Figure 23 details a screen for prompting search criteria generated by the criteria requesting step in *Figure 21*;

Figure 24 illustrates the displaying of titles of associated files generated by the procedure shown in *Figure 21*.

Detailed Description of The Preferred Embodiments

The invention will now be described by way of example only with reference to the previously identified drawings.

5 A data distribution environment is illustrated in *Figure 1* in which data, received from a plurality of data sources **101**, **102**, **103** is supplied to a data processing, storage and retrieval system **104**. Data sources **101** and **102** supply data directly to processing system **104** while data source **103** supplies data via a local area network **105**, thereby allowing user terminals **106** and
10 **107** to gain direct access to their local data source **103**.

 The processing system **104** provides access to a plurality of users, such as users **111**, **112**, **113**, **114**, **115**, **116** and **117**. User **111** has direct access to the processing system **104** while users **112**, **113** and **114** gain access to the processing system **104** via the Internet **118**. Users **115**, **116**
15 and **117** exist within a more sophisticated environment in which they have access, via a local area network **119** to their own local database system **120** in addition to a connection, via an interface **121**, to the data processing system **104**.

 All incoming data from data sources **101** to **103** is categorised with a
20 key word in seven separate fields, comprising "market sector", "location", "company name", "publisher", "publication date" and "scope". Users, such as users **112** to **117** may specify almost any term as the basis for a search and are then prompted by an equivalent word or phrase which constitutes more preferred search parameters. For example, a user may specify a search word
25 such as "confectionery" and the system will prompt the user to consider narrower terms such as "chocolate" along with related terms such as "cakes" or "desserts", or broader terms such as "food". From a simple request, a user is given an option of focusing further or of taking a broader overview of the subject under consideration.

The scope of an article refers to the context in which the document or article was written. For example, the scope field may consider questions as to whether the article concerns "mergers and acquisitions" or "seasonal trends" et cetera. Such terms are useful in gathering related information from a wide variety of industries and markets and may prove invaluable for particular applications.

The same criteria used for indexing are offered for search purposes and the same indexing terms are used for all documents across a range of specific databases. An overview of procedures performed by the data processing system 104 is illustrated in *Figure 2*. At step 201 preferred terms for association with data files are specified. This step is essentially performed as an "off-line" process; establishing the environment for allowing source data to be processed as it is received from sources.

Steps 202, 203 and 204 represent on-line procedures after the preferred terms have been specified at step 201. At step 202 the processing system 104 receives data from sources such as sources 101, 102 and 103. The source data may be transmitted using different protocols, formats and standards therefore the processing system performs a standardisation process so that the data may be stored locally at the data processing system using standardised formats.

At step 203 the data is processed so as to enhance a user's ability to identify information of interest. Files of machine-readable data received from the sources are associated with specific preferred terms which may be considered as defining particular information types. A file is considered and individual data elements, usually in the form of natural language words, are examined to identify occurrences of specified data types. The purpose of this association is to identify files of data which are of interest in relation to particular topics. This enables a user to organise a search which should result in useful information being supplied to said user, with reference to said topics and defined terms, from an extremely large database of stored data

files. In this way, the technical procedures performed by association step 203 significantly enhances the overall functionality of the system and provides an industrially applicable approach to allowing highly focused sets of information to be supplied to a user in preference to large volumes of data; much of which will tend to be totally irrelevant.

In order to achieve this, the files of data are considered and are given a score representing a numerical value as to their relevance with respect to the predefined topics. Scores are adjusted in response to the number of identified occurrences of a specified data type. Furthermore, these scores are also adjusted in relation to the size of the data contained within the file. In particular, occurrences of data types in relatively small files are given a higher weighting with occurrences in larger files being given a lower weighting. Thus, the adjustment of scores is related inversely to the actual size of the data file. Thereafter, a threshold for the scoring values may be set and information types are associated with particular files dependent upon whether particular value scores fall on one side or on the other side of this threshold.

At step 204 a search is performed, in response to preferred terms identified by a user such that information of interest may be identified within the data stored by the data processing system 104 and transmitted to user terminals, such as terminal 111, over transmission channels as illustrated in *Figure 1*.

Processing system 104 is detailed in *Figure 3*. Data signals from data sources 101 to 103 are supplied to input interfaces 301 via data input lines 302. Similarly, output data signals are supplied to users 111 to 117 via an output interface 303 and output wires 304. Input interface 301 and output interface 303 communicate with a central processing system 305 based on DEC Alpha integrated circuitry. The central processing system 305 also communicates with other processing systems in a distributed processing architecture. Processing system 104 includes eight Intel chip based processing systems 311 to 318, each implementing instructions under the

control of conventional operating systems such as Windows NT.

5 An operator communicates with the processing system **104** by means of an operator terminal, having a visual display unit **321** and a manually operable keyboard **322**. Data files received from sources **101** to **103** are written to bulk storage devices **323** in the form of large magnetic disk arrays. Data files are written to disk arrays **323** after these files have been associated with preferred terms, as illustrated at step **203**. These association processes are performed by the subsidiary processors **311** to **318** and the central processing system **305** is mainly concerned with the switching and
10 transferring of data between the interface circuits **301**, **303** and the disk arrays **323**.

The central processing system **305** communicates with the subsidiary processors **311** to **318** via an Ethernet connection **324** and processing requirements are distributed between processors **311** to **318**. Having
15 addressed a subsidiary processor **311** to **318** the transferring of data to an addressed processor is performed. Each individual incoming data file is supplied exclusively to one of the subsidiary processors. The selected subsidiary processor is then responsible for performing the association process, to identify preferred terms relevant to that particular data file. Thereafter, the associated data file is returned to the central processing
20 system **305**, over connection **324** and the central processing system **305** is then responsible for writing the associated data file to the disk array **323**. In this way, it is possible to scale the degree of processing capacity provided by system **104** in dependence upon the volume of data files to be processed in this way. The central processing system **305** also maintains a table of
25 preferred terms, pointing to particular data files which have been identified as relevant to said preferred terms.

Process **201** for specifying preferred terms for association with data files is detailed in *Figure 4*. At step **401** a preferred term is selected and at
30 step **402** an outline (OTL) file is generated or modified. At step **403** a

question is asked as to whether another term is to be processed and when answered in the affirmative control is returned to step 401, allowing the next term to be processed at step 402. Eventually, all of the terms will have been processed resulting in appropriate generations or modifications to their related outline files. Consequently, the question asked at step 403 is answered in the negative whereafter at step 404 data structures are initialised by parsing the OTL files generated at step 402.

Step 402 for the generation or modification of outline files is detailed in *Figure 5*. At step 501 a visual OTL editor is opened resulting in the editor's visual interface being displayed on VDU 321. At step 502 a question is asked as to whether an existing file is to be loaded for modification and if answered in the negative a new OTL file is created at step 503. If the question asked at step 502 is answered in the affirmative, step 503 is bypassed and at step 504 modifications or additions are made to the OTL definition. At step 505 the OTL modifications created at step 504 are tested on a sample of test data and at step 506 a question is asked as to whether another modification is to be made. When answered in the affirmative, control is returned to step 504 resulting in further modifications or additions being made to the OTL definitions. When answered in the negative at step 506, the new or modified OTL file is saved at step 507.

When performing modifications or additions at step 504, a graphical representation of the OTL file data is presented to an operator via the visual display unit 321. An example of a display of this type is illustrated in *Figure 6*, representing a graphical illustration of a specific OTL file.

The OTL file stores definitions in an hierarchical tree structure and this structure is represented in the graphical view as shown in *Figure 6*. A representation of the tree may be contracted or expanded and the possibility of expanding a particular branch is identified by a plus sign on a particular line, as shown at 601. Similarly, when a particular branch has been fully expanded, the line is identified by a minus sign as shown at 602. Definitions

within the file consist of rules, words and labels. The labels allow relationships to be defined between various parts of the file and between individual files themselves. The words identify specific words within an input file of interest and the rules define how and what weights are to be attributed to these words. Each rule line includes, at its beginning, a weight value 603 representing the score that will be attributed when a particular rule condition is met. Rules may also have leaves and the rule defines the way in which scores generated from leaves are combined.

OTL file data represented graphically in the form shown in *Figure 6* is actually stored in a data file having a format of the type shown in *Figure 7*. The actual data file shown in *Figure 7* corresponds to the data display in *Figure 6* but in *Figure 7* all of the data, some of which has been rolled up in *Figure 6*, is present. The data contained within the file shown in *Figure 7* is manipulated interactively by an operator in response to the graphical interface displayed as illustrated in *Figure 6*. Score values 603 are also identified in the data file shown in *Figure 7*.

Displayed line 601 in *Figure 6* is generated from line 701 of the actual stored data. The syntax of the language used for recording the data, as illustrated in *Figure 7*, may vary and the example shown is specific to this particular application. However, the underlying functionality of the language may be considered with reference to the diagrammatic representation shown in *Figure 8*.

Purely to provide a specific example, this particular outline file is concerned with the topic of the oil industry and therefore the purpose of the OTL file is to identify words and phrases within an input file so as to provide an indication as to how relevant that input data is to users having an interest in the oil industry. Thus, the purpose of procedures exploiting these OTL files is to generate evidence showing that a particular data file conveys information which may be of interest to those studying the oil industry.

The outlines analyse data files in order to produce numerical evidence as to the relevance of a particular file with relation to a particular topic. The OTL definitions and structures are determined empirically and would be modified and upgraded over a period of time. The system does more than merely register the existence of a particular word item by placing the word items within an interacting structure; the nature of which is illustrated in *Figure 8*. The particular entry, given label "oil-industry-mkt" relates to marketing aspects of the oil industry and as such can contribute to an overall score as to the pertinence of incoming data to this particular topic. The first line **801** shows that this particular contribution may provide a total score of forty percent. This total of forty percent is then subdivided such that at line **802** the presence of the phrase "buying oil from" has a score of fifty percent. Thus, the total contribution made the presence of this phrase consists of fifty percent of forty percent, ie a total of twenty percent being made to the total contribution. Similarly, as shown at line **803** and below, particular words may be identified which result in contributions of sixty percent of thirty percent of forty percent. Thus, a complete OTL file is structured in this way with particular words and phrases making contributions to an overall score value. These words and phrases may also be specified in the rules as making single contributions or being allowed to accrue.

Examples of score value **603** are illustrated in *Figure 8* at **804** to **815**. The hierarchical structure in *Figure 9* consists of a plurality of branches with lowest level entries being considered as leaves. Each leaf has a score value associated with it and values **809** to **815** are leaf score values. Above these, branch score values exist such that score values **807** and **808** exist at the lowest level of branching with score values **805** and **806** being at the next level of branching further up each connected to the highest level of branching illustrated by score value **804**.

A total score value for a particular occurrence, detected at any level within the hierarchical tree, results in a final score contribution derived from

the product of the score value assigned to that particular level with all score levels identified while ascending the tree structure back to its root.

The score contributions are produced and possibly accumulated when occurrences of the specified elements are identified. This provides a numerical weight to assess whether a file being processed should be associated with a particular information type. The present invention, as implemented within the preferred embodiment, further adjusts these score weight in relation to the size of the overall data file. In particular, it is the branch score values (804 to 808) which are modified in preference to leaf values (809 to 815).

Subsidiary processor 311 is detailed in *Figure 9*. The processor includes an Intel Pentium processing unit 901 connected to sixty-four megabytes of randomly accessible memory 902 via a PCI bus 903. In addition, a local disk drive 904 and an interface circuit 905 are connected to bus 903. Interface circuit 905 communicates with the TCP/IP network 324.

Random access memory 902 stores instructions executable by the processing unit 901, in addition to storing input data files received from the data sources 101 to 103 and intermediate data. Operations performed on processing unit 901, in response to instructions read from memory 902 are identified in *Figure 10*.

At step 1001 temporary memory structures are cleared and at step 1002 an OTL description file is selected. At step 1003 an item in the OTL file is identified and at step 1004 a question is asked as to whether the item selected at step 1003 is a rule definition. If this question is answered in the affirmative, a rule object is defined at step 1005. Alternatively, if the question asked at step 1004 is answered in the negative, to the effect that the item is not a rule definition, a question is asked at step 1006 as to whether the item is a word definition. If this question is answered in the affirmative, a dictionary link is created at step 1004.

At step **1008** a question is asked as to whether the item is a label and when answered in the affirmative a new entry is created in a label list, whereafter at step **1010** a question is asked as to whether another item is present. After executing step **1005** or after executing step **1007**, control is
5 directed to step **1010**.

When the question asked at step **1010** is answered in the affirmative, to the effect that another item is present, control is returned to step **1003** and the next item is identified in the OTL file. Eventually, all of the items will have been identified resulting in the question asked at step **1010** being answered
10 in the negative. Thereafter, at step **1011** a question is asked as to whether another OTL file is present and when answered in the affirmative control is returned to step **1002** allowing the next OTL description file to be selected. Thus, this process continues until all of the OTL files have been considered resulting in the question asked at step **1011** being answered in the negative.

For each OTL file considered, by being selected at step **1002**, a rule base is generated and a plurality of such rule bases are illustrated in *Figure 11*. Thus, a first OTL file processed in accordance with the procedures shown in *Figure 10* results in the generation of a first rule base **1101**. Similarly,
15 further iterations of the procedures shown in *Figure 7* result in the generation of rule bases **1102** to **1109**. Typically, for a specific installation, in the order of three thousand rule bases would be generated by execution of the procedures illustrated in *Figure 10*.
20

Rule bases **1101** to **1109** are stored in memory **902**, which also provides storage space for a dictionary **1121**, a label list **1122** and a data
25 buffer **1123**. The dictionary stores a list of words which have importance in any of the stored rule bases. Associated with each word in the dictionary there is at least one pointer and possibly many pointers to specific entries in specific rule bases **1101** to **1109**. Thus, the words identified at **803** in *Figure 8* would all be included in dictionary **1121**. Entries within the dictionary **1121**
30 are implemented upon execution of step **1007** in *Figure 10*. Similarly,

execution of step 1009, creating a new entry in the label list, allows a label to relate to rules that are elsewhere in the tree structure. Step 203, as shown in *Figure 2* for associating preferred terms with source files, is detailed in *Figure 12*. At step 1201 central processor 305 obtains access to one of the subsidiary processors 311 to 318. The central processor then expects to receive authorisation so that communication may be effected with one of the subsidiary processors, after a connection has been established, the source file is supplied to the selected subsidiary processor at step 1203 and at step 1204 the data is processed to determine associated preferred terms.

After performing the processing at step 1204, the results are transmitted back to the central processing system at step 1205 and at step 1206 data with associated preferred terms is stored and data pointers associated with the preferred data terms are updated at step 1207.

Step 1204 for the processing of data to determine associated preferred terms is detailed in *Figure 13*. The overall processing is broken down into three major phases, consisting of a triggering phase at 1301, followed by a scoring phase at 1302 followed finally by a list generation phase at step 1303.

Triggering phase 1301 is detailed in *Figure 14*. At step 1401 a section of the data, such as its title, market sector or main body of text, is identified and at step 1402 an item of the identified section is selected. At step 1403 a question is asked as to whether the item indicates a new context, which may be considered as a grammatical marker in the form of a full stop, capital, start of a sentence or quotation marks et cetera. When answered in the affirmative new context information is supplied to all rule bases 1101 to 1109 at step 1404 and control is then directed to step 1407.

If the question asked at step 1403 is answered in the negative, step 1404 is bypassed and a look-up address is obtained for rule objects in rule bases from the dictionary at step 1405. Thereafter, at step 1406 all addressed objects are triggered and a multiplication of scores is effected by a

score weighting factor. Thereafter, at step 1407 a question is asked as to whether another item is present and when answered in the affirmative control is returned to step 1402.

5 Eventually, all of the items for a selected section will have been considered resulting in the question asked at step 1407 being answered in the negative. Thereafter, at step 1408 a question is asked as to whether another section is to be considered and when answered in the affirmative control is returned to step 1401.

10 At step 1401 the next section is identified and steps 1402 to 1408 are repeated. Eventually, all of the sections will have been considered and the question asked at step 1408 will be answered in the negative.

15 As shown in *Figure 8*, each lowest level leaf of the hierarchical tree has a numerical value associated with the identification of a particular item, as identified generally at 803. If the amount of data contained within a particular file is less than what would generally be accepted, scores are further adjusted in relation to this size so as to improve the association of files with particular information types. This further adjustment is performed at the lowest leaf level (an example of this being level 803 in *Figure 8*) and these leaf values are multiplied by a file weighting factor, derived from the size of the file, which is triggered at step 1406 as shown in *Figure 14*.

20 The generation of a file weighting factor W is illustrated in *Figure 15*. Experiments have shown that below a certain file size, the irregular distribution of evidential terms, referred to as granularity, can effect the accuracy of the association process and therefore requires compensation. In order to provide compensation, a threshold value is identified, below which compensation is required, and recorded by variable T . A typical example for T would be two thousand and forty-eight bytes. The size of the current file is recorded in variable S and a weighting constant, such as zero point eight (0.8), is stored by variable N . From these values, weighting factor W is derived as follows. If the size S of the current file is smaller than threshold T ,

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weighting factor W is calculated by subtracting the size S of the current file from the threshold T and dividing this by the threshold T . This partial result is then multiplied by the weighting constant and added to unity. Alternatively, if the size of the current file is not smaller than the threshold T , the weighting factor is set to unity.

The threshold value T represents the minimum file size that can be indexed reliably and files smaller than this value, when detected, result in further adjustments being made to the identification process so as to compensate for this problem. The threshold value could be calculated on an on-going basis so as to provide, for example, the average of the previous one thousand files considered. However, given the inherent unpredictability of file size distribution, it is better to specify a threshold value and, in some circumstances, it may be preferable to modify the threshold value in order to achieve a particular result. Furthermore, the weighting constant may also be modified in response to particular data types and experiments have shown that by optimising the weighting constant and by optimising the threshold value it should be possible to obtain a ten percent improvement in terms of the number of files that are selected correctly for a particular category.

The relationship between weighting factor and file size is illustrated graphically in *Figure 15* and it can be seen that, as the file size falls below the threshold value, the weighting factor is linearly increased up to the value of the weighting constant. Alternatively, a more sophisticated procedure may be achieved, having a non-linear relationship, by using interpolated look-up tables.

An example of a short data file is illustrated in *Figure 16*. The file does not contain many words therefore it is unlikely that enough words would be identified so as to provide evidence for the data file to be included within a particular category identified by its associated preferred terms. *Figure 16* also shows particular words and phrases that have been highlighted, so as to identify them as having being caught by a particular rule base. Thus, a

decision then has to be made as to whether these highlighted words provide sufficient evidence for the data file to be included. The present procedures, as illustrated in *Figure 15*, would increase the likelihood of a file of this type being included correctly and as being pointed to by a particular preferred term.

Scoring phase **1302** is detailed in *Figure 17*. At step **1701** a rule base is selected and at step **1702** a score variable is re-set to zero. At step **1703** a branch is identified for score accumulation/accrue and at step **1704** scores are accumulated or accrued from triggered rules attached to the branch. At step **1705** a question is asked as to whether another branch is to be considered and when answered in the affirmative control is returned to step **1703**. A next branch is selected at step **1703** with procedure **1704** being repeated. Eventually all of the branches will have been considered resulting in the question asked at step **1705** being answered in the negative.

At step **1706** an overall score in the range of zero to one hundred is stored for the rule base and at step **1707** a question is asked as to whether another rule base is present. When answered in the affirmative, control is returned to step **1701** and steps **1701** to **1707** are repeated. Eventually, all of the rule bases will have been considered and the question asked at step **1707** will be answered in the negative.

The operations illustrated in *Figure 17* may be considered with reference to the illustration of the structure in *Figure 8*. Thus if any of the defined words at **803** are identified within the file a provisional score of one hundred will be allocated. However, the process as shown in *Figure 17*, must then ascend up the branches so that any scores lower down will be modified in response to scores higher up the structure.

Phase **1303** for the generation of a list of associated preferred terms is detailed in *Figure 18*. At step **1801** a rule base is identified having a score greater than a predetermined threshold. Thus, for a particular application a threshold may be set at forty-eight percent. At step **1802** additional triggered

preferred data characteristics are identified by associating successful rule bases with parent categorisations by rule base links.

At step 1803 lists of successful and inferred rule bases are combined to form overall lists of preferred data characteristics. Step 1803 results in data being generated by a subsidiary processor, such as processor 311, which is then supplied back to the central processing system 305. Central processing system 305 is responsible for constructing a table of the type shown in *Figure 19* in which an entry is present for each preferred term. The specific preferred terms are stored in column 1901 and, for each of these terms, column 1902 defines a specific pointer to a position in memory associated with the central processing system 305. Specific data files are identified by file names and the number of files associated with each preferred term is variable, depending on the nature and the amount of input data being considered. Thus, in order for this data to be accessible quickly while optimising use of the storage capacity within the central processing system 305, an indication of the file names is stored in the form of a linked list as illustrated in *Figure 20*.

Referring to *Figure 19*, the preferred term "OIL_INDUSTRY" has been associated to a pointer 0F8912. Address 0F8912 is the first in column 2001 of the linked list. Column 2002 identifies a particular file name and column 2003 identifies the next pointer in the list. Thus, entry 0F8912 points to a particular file with the file name "OIL_INDUSTRY_NETHERLAND_3" with a further pointer to memory location 0F8A20. At memory location 0F8A20 a new file name is provided, illustrated at column 2002 and again a new pointer is present at column 2003. Eventually, all relevant files will have been considered and the end of the list is identified by address 000000 at the pointer location in column 2003.

In an active system, the database 323 will be continually updated and users will continually be given access to the database, all under the control of the central processing system 305. Thus, with reference to *Figure 2*, it should

be understood that the association step illustrated at **203** and the searching step at **204** are actually concurrent and will be effected in response to the availability of data and the demand for searching respectively.

5 Procedures **204** for performing a search in response to a user request are detailed in *Figure 21*. At step **2101** a user logs onto the system and at step **2102** a search method is identified. At step **2103** search criteria are defined and at step **2104** the search criteria are processed to determine preferred terms. At step **2105** a list of preferred terms are supplied to the central processing system **305**.

10 At step **2106** a question is asked as to whether the host has responded and when answered in the affirmative titles of associated data files are displayed at step **2107**.

15 At step **2108** a question is asked as to whether the user wishes to view identified data and when answered in the affirmative the data is viewed; after being downloaded over the communication channel, at step **2109**.

At step **2110** a question is asked as to whether another search is to be performed and when answered in the affirmative control is returned to step **2102**.

20 Step **2102** requires the search method to be identified and in order to achieve this a user is prompted by a screen display of the type shown in *Figure 22*. Thus, a plurality of text boxes are presented to the user inviting the user to specify a search method.

25 Step **2103** for the defining of search criteria results in the user being prompted by a screen of the type shown in *Figure 23*. Terms providing a basis for the user's search are displayed in a window **2301**. Preferred terms are displayed in uppercase characters, such as the entry shown at position **2302**.

30 The displaying of titles of associated files at step **2107** results in the user seeing information displayed of the type illustrated in *Figure 24*. Each entry, such as entry **2401**, includes a check box **2402**. Check boxes **2402**

allow a particular item to be selected by a user such that the actual information file may be supplied to the user from the central database over a communication channel.

Claims

1. A method of associating files of machine-readable data with information types, comprising steps of
5 examining data elements in a file to identify occurrences of specified data types;
adjusting a score in response to said identified occurrences;
further adjusting said score in relation to a size of said data; and
associating said information types with processed files in dependence
10 upon said score values.
2. A method according to claim 1, wherein said further adjustment is performed if the size of said data is below a predetermined threshold.
- 15 3. A method according to claim 1 or claim 2, wherein said further adjustment is performed up to a predetermined maximum weighting value.
4. A method according to any of claims 1 to 3, wherein said information types are expressed as preferred terms and are specified by
20 information outlines.
5. A method according to claim 4, wherein said information outlines define preferred terms in a branching hierarchical structure and said adjustable values are defined at branches of said structure.
25
6. A method according to claim 5, wherein said further adjustment includes adjustment at a plurality of said branches.
7. A method according to claim 6, wherein said a score value is
30 determined by multiplying values stored at branches throughout said

hierarchy.

5 8. A method according to claim 1, wherein said relation for adjusting said score is an inverse relation, such that said score is adjusted inversely in relation to a size of said data.

10 9. A method according to claim 8, wherein said size of said data is determined in terms of the volume of the stored file, representing the number of characters present in the file.

 10. Apparatus for associating files of machine-readable data with information types, comprising

 examining means for examining data elements in a file to identify occurrences of specified data types;

15 adjusting means for adjusting a score in response to said identified occurrences and for further adjusting said score in relation to the size of said data; and

 associating means for associating said information types with processed files dependent upon said score values.

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 11. Apparatus according to claim 10, wherein said adjusting means further adjusts said score if the size of said data is below a predetermined threshold.

25 12. Apparatus according to claim 10 or claim 11, wherein said adjusting means is configured to perform said further adjustment up to a predetermined maximum weighting value.

30 13. Apparatus according to any of claims 10 to 12, wherein said associating means is configured to associate said information types and said

information types are expressed as preferred terms specified by information outlines.

5 **14.** Apparatus according to claim 13, including means for storing a branching hierarchical structure of preferred terms defined by said information outlines, wherein said adjusting means is configured to adjust values defined at branches of said structure.

10 **15.** Apparatus according to claim 14, wherein said adjusting means is configured to adjust values at a plurality of said branches.

15 **16.** Apparatus according to claim 15, including means for multiplying values stored at branches throughout said hierarchy to produce said score value.

17. Apparatus according to claim 10, wherein said adjusting means is configured to further adjust said score inversely in relation to a size of said data.

20 **18.** Apparatus according to claim 17, including means for determining the size of said data in terms of the volume of the stored file representing the number of characters present in the file.

25 **19.** A method of associating files of machine-readable data substantially as herein described with reference to the accompanying drawings.

30 **20.** Apparatus for associating files of machine-readable data substantially as herein described with reference to the accompanying drawings.



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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G4A (AUSB)

Int Cl (Ed.6): G06F (17/30)

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP0822502 A1 BT. See page 7 lines 1-15.	1,10 at least
X	EP0364179 A2 NeXT. See the equation on page 4.	1,10 at least.
X	US5659766 Xerox. See column 6 lines 56-67, especially lines 62-63.	1,10 at least
X	US5598557 Caere Corp. See the equation in column 7.	1,10 at least

X Document indicating lack of novelty or inventive step
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